PROCEEDINGS

First

Joint Military-Industry
Packaging
and
Materials Handling
Symposium

Department of Commerce Auditorium
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October 10, 11, and 12, 1955

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GENERAL CONFERENCE COMMITTEE

First Joint Military-Industry Packaging
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The sponsors wish to express their appreciation to the National Security Industrial Association whose Education Task Group so ably assisted in planning for this symposium and in securing the participation of the many industry leaders whose names are included in the symposium proceedings.

Program for the First Day

Monday, October 10, 1955

Vice Admiral M. L. Royar, SC, USN
Chief of Naval Material, Chairman

Monday AM   Oct. 10, 1955

Address of Welcome

The Honorable Sinclair Weeks
Secretary of Commerce

I am very happy to have the privilege of coming here and welcoming you to the Commerce Auditorium for the purpose for which you are gathered today, a very important mission in my judgment. The fact that so many are here representing industry and the Armed Services and the Department of Commerce which, in a sense, itself represents industry -- at least we like to think so -- is a striking and very significant thing because it is obvious that Defense will not be in shape to function unless it is backed very adequately and efficiently by industry -- I need not tell anyone gathered here or anyone who knows anything about the facts that industry, under today's conditions of materials and equipment and whatnot, is today almost another right arm of the defense establishment.

You are gathered here not particularly because of the material side of the picture but you are here representing packaging and material handling concerns. I had a little experience just before I came to Washington which I think is an example of some of the problems you face -- I never thought of it until I was drinking a cup of coffee upstairs -- isn't that right, Admiral? The business I was engaged in then was selling a product to the Armed Services and it came to my attention that because of packaging requirements we had to charge the Armed Services about five times as much for that product as we had to charge a commercial user.

Now, I am well acquainted with the fact that the Armed Services, because they have equipment and material that is stored and readied all over the world, practically in all kinds of climates and all kinds of weather conditions, have to attend to packaging and material handling to a much greater extent than the business would; but I suggest that when you get a difference of that character you can realize just how important the part you play in this whole picture is and, therefore, when I see gathered here 7-800 people who have come down here to attend this first conference on packaging and material handling, it gives me quite a lot of hope for more efficient results, and I am sure they will come.

The Commerce Department has been happy to join in this errand that you are embarked on today. That is what we are here for. Our Business and Defense Services Administration is here to represent business on a peacetime basis and we

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also have to try to help implement the policies laid down by the Office of Defense Mobilization insofar as preparation for war is concerned. This, as I say, is your first conference. I think our Containers and Packaging Division of the BDSA has been much concerned with the preparation for this meeting and I hope the meeting will go off well.

As I have pointed out, and as your Chairman has pointed out, it is the first time, I think, this has happened. It is a great augury for more efficient results as we move a. .ng in that great endeavor.

It is only my purpose to welcome you, which I do and I hope you will come again, and I hope the Department of Commerce can be a helpful factor in this project. All we're here for is to try to help.

Thank you so much for your attention, and good luck to you in your work today.

Monday AM Oct. 10, 1955

Military Keynote Address

The Honorable T. P. Pike

Assistant Secretary of Defense (Supply and Logistics)

This morning we are starting a three day session on packaging and materials handling which will be a most significant gathering of military and industry leaders dedicated to improvement in these areas. I believe it is most fitting that the extremely important, but frequently overlooked, subjects of packaging and materials handling should command the interest of so large and capable a group as this.

When this session ends on Wednesday afternoon, I am confident that it will have been one of the most productive meetings ever held. I say this in humble recognition of the tremendous capacity for constructive analysis and criticism which you men and women represent.

I am pleased to learn that we have in attendance a group of representatives from the services of our Canadian neighbor, and I hope that in the discussions which will take place in these three days you gentlemen from Canada will also find answers to some of your unsolved problems and that you will give us the benefit of your experience and thinking on matters which may come up.

During the course of these meetings each of you will come to understand more fully the basic differences in military and industry operations. Our military organizations are maintained for the primary purpose of defending our country against aggression. They are also called on to render assistance in times of disaster such as the recent floods in the northeast.

World War II and the more recent Korean conflict clearly demonstrated that we must be ready at all times. It is imperative that we have on hand and ready to go considerable quantities of each of the materials and equipment which may be needed to cope with any foreseeable condition. Since we humans are not ordinarily gifted with the ability to foretell

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the time or conditions of the next national disaster, it frequently becomes necessary to keep a considerable percentage of our inventory in stock for many years. Even the wealthiest nation in the world cannot buy production lead time when disaster strikes.

This, then, is the essential difference between the packaging requirements of the military and industry. In the military package we must provide the added protection which may be needed to meet the possibility of prolonged storage and the natural and man-made distribution hazards which accompany any emergency. Commercial packages, on the other hand, can be designed to provide just the degree of protection needed to carry and effectively display the item through established trade channels at a relatively high turnover rate. If each of you here today will realize this basic difference, many misunderstandings between military and industry packaging technicians will be eliminated.

The primary purpose of our meeting today is to establish a mutual understanding of this basic difference between military and commercial operations and to consider how that difference is reflected in packaging and materials handling practices followed by the services. In addition, my military associates intend to lay before you much of the unclassified development work being done under military sponsorship so that industry may share the fruits of our efforts. We hope to also answer some of your questions concerning government procedures and practices, many of which are required by existing law. In return, the military representatives in attendance hope to learn of new and forthcoming industrial developments which have a potential application in their field.

The Packaging and Materials Handling industries, as we know them today, have had a prodigious growth from their meager beginnings of a few decades ago. Today we recognize the packaging industry as a 10 billion dollar a year giant. The growth of the materials handling industry is graphically represented by comparing the 6 million dollar annual value of industrial truck production twenty years ago with a recent Department of Commerce estimate of 350 million dollars in 1955. The growth of this industry has parallelled the recognition of the fact that the cost of handling an item during production is frequently the greatest single production cost. Studies by a major manufacturer of heavy electrical

equipment revealed that the materials handling cost - from the raw materials to finished product - represented 50% of total production cost.

The recognition of packaging and materials handling as distinct fields of endeavor within the military is likewise of recent origin. Born of the demands of total war, technicians in these fields are now recognized as an essential element in military logistic planning. The fallacy of frenzied production of vast quantities of critical military equipment which is shipped thousands of miles to contribute to the defense effort, only to find that it has been destroyed by attack of the elements and poor handling facilities, was demonstrated all too clearly in the earlier stages of World War II. Never again must our nation be called upon to shoulder such a waste of our natural resources and capability in the midst of so desperate a need. The continuation of packaging and materials handling concepts born of bitter experience in the midst of that conflict is our only assurance that there will be no recurrence of the disastrous conditions we faced in 1943.

Lest this statement be interpreted as meaning that every item packaged for the military must have the maximum protection, I hasten to add that all of the military departments subscribe to the Department of Defense packaging policy, which requires that the degree of protection provided any item be in accordance with the known or anticipated storage and distribution hazards. Thus, items which are purchased for immediate use or for routine use at an established military activity are normally purchased in the same package which a commercial supplier provides for the retail trade. On the other hand, the insurance factor provided by so-called "military packaging" must be had when materials are purchased for use at an indefinite time or at an unknown destination. I am happy to report that, due to the increasing importance industry has placed on developing packages that will assure the customers receipt of an undamaged item, the gap between the "military package" and the retail trade package is rapidly decreasing. In some areas the commercial retail package has been found to be adequate for all our military uses and such items are regularly purchased as packaged by the producer.

The objectives of military packaging are essentially the same as the objectives for which industry is striving in package design. As stated in the Department of Defense Instruction which embodies the military packaging policy, these objectives are:

A. Provide efficient and economical protection to supplies, materials, and equipment from physical and mechanical damage during handling, shipment and storage from the time of original purchase until used.

B. Assure maximum life, utility and performance of supplies, materials and equipment through prevention of deterioration.

C. Provide a means for efficient receipt, storage, inventory, transfer and issue.

D. Provide the identification, handling and shipment markings.

E. Assure the greatest practicable uniformity in the development of requirements for preservation, packaging, packing and marking for shipment of the same or similar items.

F. Effect economies by assuring the use of packages and shipping containers of a minimum weight and cube consistent with anticipated storage and shipment hazards.

Military standardization of packaging requirements is an area which frequently causes concern to suppliers of military equipment. Ardent proponents of standardization insist that items should always be packaged in the same manner regardless of supplier or point of use. On the other hand, we receive plaintive pleas from suppliers who say in effect: "I will give you a package which will provide equal or more protection to your product at the same price, (and sometimes for less) if you will accept the kind of package that I am equipped to produce most efficiently." This problem is particularly prevelant in connection with the watervapor-proof flexible barrier package and the sealed metal can.

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It is not our desire to request a supplier to package a single item in more than one way. However, due to the varying requirements of using activities, this practice becomes essential at times. This situation is most readily realized when one compares the needs of a submarine with a cruiser or aircraft carrier. On the submarine, because of the extremely cramped quarters, it is essential that each spare part aboard be protected with the least possible loss of space. Conforming wraps and dipcoat seals are nearly standard requirements and packages generally contain a single item. This unit of one is required, not only to allow for ease of storage, but to provide continuing protection for the remaining items in the relatively high humidity encountered within submarines. On the other hand, on a cruiser or carrier storage space is more plentiful and larger unit quantities are needed because of the greater amount of operating machinery and equipment. Packages of five, ten, or even one hundred like items are both practical and essential.

A similar comparison can be made between an Army depot in continental United States with ample space and controlled humidity and an advanced Air Force Base cut out of the jungle where storage space is at a premium and climatic conditions are next to impossible. Many like situations can be recounted which preclude overall and absolute standardization of packaging requirements. It is our earnest desire, however, to standardize packaging requirements to the greatest practical extent consistent with efficient military operation.

The question is often asked by industry: "When the military has specialized packaging requirements, why don't they do their own packaging and not disrupt my normal packaging operations?" It deserves a clear and sincere answer and I'm going to give it to you.

We believe that it is essential to keep industry in the military packaging business. The objectives are twofold. First, it is imperative that material be delivered to supply activities in a condition which will permit storage, re-handling, and re-shipping with a minimum of effort. This leads to efficient operation of supply activities and a minimum of delay in filling urgent shipments. Secondly, and possibly more important is the fact that if we become involved without warning in another all-out war, we cannot afford to go through the same difficulties we experienced at the start of World War II.

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Many industries will be required to divert their production to the military supply systems over night. If industry is up-to-date on military packaging and has the facilities required, it can provide the extra protection needed from the start. If not, a considerable period of time must elapse before we can expect to get the type of packaging we need. In the meantime, inadequately packaged material will flow into our supply channels and because of the pressure of urgency, be re-shipped as received to the fighting forces. From our World War II experience we know that a large percentage of such material would be worthless upon arrival. The best way to prevent this from happening is to require industry to do the packaging job in normal times as well as times of emergency. Requiring industry to do this work today is insurance in the form of facilities and trained personnel in industry which can be expended within a short time to handle the tremendous load imposed by emergency conditions.

In addition to providing a reserve of military packaging know-how and capacity, the military looks to the industrial world to serve as a proving ground for new developments in materials and techniques which have a potential military application. Last, but by no means least, we depend upon industry to sound the alarm whenever through inevitable human error or inconsistency we lose sight of the packaging objectives which I enumerated earlier.

It has been a pleasure to have been with you this morning. I hope that after this meeting you will have a clearer understanding of some of the complexities of modern military packaging. Before this morning session ends I am sure you will know more about the complexity of modern military logistics and the highly specialized handling procedures and equipment which are required.

In closing, I would like to say that I am sure this symposium will result in a worthwhile exchange of knowledge between government and industry on a subject, the importance of which can not be over emphasized. The Department of Defense continues to welcome your cooperation and assistance and looks forward to the time when the products of this program will result in improved government-industry relationships.

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Monday AM Oct. 10, 1955

Industry Key Note Address

Mr. Vincent deP. Goubeau
Vice President, Materials, Radio Corporation of America

Let me first say how honored I feel to have been selected to make the opening remarks on behalf of industry at this Joint Military-Industry Packaging and Materials Handling Symposium. That we are holding a meeting such as this is, in a sense, also a tribute to my old chief and one of our greatest Secretaries of the Navy, James Forrestal. It was his wisdom and foresight that led to the close and continuing relationship that industry and the armed services have enjoyed since the end of the war.

Packaging and materials handling have a significant role to play in the functioning of our defense services. In peacetime they can help materially to reduce the cost of operating these services and at the same time provide the most efficient utilization of weapons and materials. In time of emergency, they can sometimes be decisive in determining a military outcome. Battle engagements, and even whole campaigns, have been profoundly affected by the quality, quantity, and condition of equipment and material received by the men in the combat zones. How these materials are packaged for ultimate use, how swiftly they are delivered, their condition upon arrival, how easily they can be put into operation — these are the factors that come into play when the chips are down.

It is to nobody's discredit that, until recent years, much of the thinking that went into such problems was done on a crash basis. The scale of our effort in World War II could hardly have been foreseen in the years immediately prior to 1941. Many of us were first confronted with the importance of packaging and materials handling when, early in the war, we found that approximately forty-five per cent of our material going overseas was being received in a damaged condition. But by the end of hostilities and through really spectacular cooperation between industry and the armed services we reached the point where better than eighty-five per cent of our material being shipped overseas got there in excellent condition.

Our record today bears no more comparison to those wartime achievements than does, say, the modern jet fighter to the old Mustang. What began as a crash program has evolved into a cooperative relationship between industry and the armed forces — a relationship that not only seeks to

eliminate the problems of today but to anticipate the ones that may come tomorrow. The scope and fruitfulness of that relationship is best illustrated by the type of symposium we are holding here and the range of subjects that will be coming under discussion.

The potentialities of packaging and materials handling, both for industry and the military, are enormous. Most of us can remember back to the days when we went to the corner grocery for a couple of pounds of sugar and the clerk turned to an open bin where flies were, more or less, free to congregate. Compare that with the modern refining process that automatically feeds the sugar into a carton attached to a piece of machinery which weighs and seals the carton and delivers its contents untouched to the consumer.

But although packaging had progressed well beyond the open bin stage by the 30's, it took the impetus of global conflict and global problems to really bring it where it is today. Overnight we were introduced to the harsh necessities of finding means of preserving materials under the most extreme conditions of heat and cold. We had to allow for the widest variations in transport and delivery -- from LST to the air drop. Together, industry and the military were forced to solve such other problems as jammed warehouses and clogged systems of supply, and not only for our own locations all over the world, but for our Allies as well. But out of all this experience came concepts and methods that, as Secretary Pike has indicated, have reached the status of a ten billion dollar operation.

When peace returned, another element came into the packaging and materials handling picture. Under the keenest sort of competition, industry began searching for new methods of improving costs. Good progress was made in lowering production costs through increased output per man hour, but it seemed that we might be reaching the optimum in this direction; and, so we had to turn to the hidden or indirect costs for new economies.

Now, as you know, packaging costs represent a very substantial item in a business operation. Gradually, we began to realize that we had a great opportunity for substantial savings by getting our goods to market through improved packaging and utilization of materials handling methods developed in wartime. Not only were we concerned with the cost of the package itself, in relation to the value of the product; we were equally concerned with labor and overhead savings in the actual packing of the product, the movement of the product, and finally, its availability at its destination - whether distributor, direct consumer or, in the case of components, the production plant of the final fabricator.

Now I realize, of course, that the profit element is not paramount with the military. But I think that you have an even harder taskmaster than we in industry ever have to face. You have to account to the voting taxpayer and his elected representatives just down the avenue. So, for somewhat different reasons, you and we both find ourselves striving toward the same goals in packaging and materials handling -- the achievement of greater economies. And, as in wartime, both of us have discovered that working together has meant mutual progress. Let me give you a few examples with which I'm familiar:

For several years, proximity fuses produced by industry for the Navy were packed twelve to a corrugated container. This, in turn, was packed in a single ammunition can whose sole function was to serve as a protective packaging for fuses enroute from the manufacturer to a state-side government munitions plant for further assembly. When the fuses arrived, they were removed from the ammunition cans. In most cases the cans were then sent back to the manufacturer for refilling. So there was not only a loss of time and labor in filling and emptying the cans exclusively for domestic transit, there was the added bulkiness in shipment and the resulting higher delivery cost in weight and space. This problem was eliminated. Then the Navy asked industry what it could do with respect to palletization of fuses. After joint study, a design was submitted by industry and refined by the Navy. The result has been saving of more than a million dollars a year on this item alone.

Or take another case -- packaging of certain electronic tubes for military use. After considerable study and experimentation by a committee of JETEC - the Joint Electronics Tube Committee of industry and the services -- new packages were designed which resulted in package cost reductions ranging from thirty-five per cent to eighty per cent; weight reductions from twenty-six per cent to fifty-five percent, and size reductions from forty-two per cent to seventy-four per cent. You can see the effect of this, not only in terms of cost, but even more important, in case of transportation. In a similar example of this close working relationship, hundreds of thousands of dollars are being saved annually through the joint industry-military development of specially designed returnable containers for items ranging from electronic testing meters to airplane engines. These examples illustrate the way in which the two of us, by pooling our experience and know-how, have succeeded in getting more cost mileage out of the same items.

It is sometimes difficult to determine proper relationship of packaging costs to the value of the product being shipped.

To say that the ideal percentage should be one or two or five per cent would be misleading. Whether it be for a military or a commercial item, closest analysis should be made of this package-to-product relationship. There are few items, even in military hardware, which justify a packaging job costlier than the content itself. Certainly, those responsible for procurement, whether in the military or in private business, need to become more aware of the factors which go into packaging. By the same token, those concerned with packaging should have some knowledge of the procurement picture.

But regardless of what cost economies may be achieved, the significance of packaging for the Armed Forces goes far beyond this factor. Vitally important is the protection of the product itself and its usability under all conditions. Here it becomes more than just guarding against physical damage to the product. Due care, for example, must be given to the chemical relationship between the product and its packaging material. We have to consider fungus growths caused by some types of packing material. During the war, for example, we found that some crating wood gave us trouble. Something in its chemistry caused fungus to develop on many of the metal products it encased. We found that out only after delivery had been made overseas. Nowadays we are spotting many of these things before they reach the crating stage.

We also have to take into account the matter of seepage or water damage, and anybody who has ever taken part in an amphibious operation will know exactly what I mean. There isn't much time to send the package back to the manufacturer with the notation, "Contents damaged; please replace." And so, among other things, we in industry and you in the armed services have worked together closely and successfully in the development and testing of a whole variety of protective packages for military use. I mention one, the vapor corrosion inhibitors to prevent oxidation in metals.

The problem of protection in transit is being solved in still another fashion. Within the past few years, great strides have been made in pre-shipping package tests, such as these established by the National Safe Transit Committee and others set up by the various armed services. Although these tests may not unravel all of the transit kinks that may possibly develop, they are a definite advance over the old trial and error methods.

Now this entire field of scientific package testing is something that we have only begun to move in on. We have to recognize the shortage of skilled technicians available to carry on this work, and in this connection it is encouraging to note the excellent courses on packaging now being set up in several of our colleges and universities.

I want to mention one final factor in this matter of packaging, and that is the matter of accessibility -- simplified opening of packages; ease in disassembling packing material and in making immediate use of the equipment. If it is important for us to save the housewife from a bruised thumb, how much more important is it for the man in the slit trench or behind a ship's anti-aircraft battery. For him it can split the second between life and death. Multiply this element of speed by the factor of climatic conditions and you can begin to see the complexities of the problem. Weather, for example, is one of the major considerations, if not the major one, that must enter the packaging picture in the Arctic. And so, if we are to maintain a posture of instant defense and retaliation, proper packaging of equipment for all conditions of use anywhere must play an even greater role in our planning and development. The fact is that many of our present packages fall short of this goal. That, again, is a joint responsibility of industry and the services.

Our second subject of discussion is materials handling. In its relationship to packaging, it has the responsibility of establishing methods and control of mechanical equipment to support first, the flow of material, and second, warehousing. Here the objectives are to save money, time, and labor.

A good mechanical handling system is essential to survival in a system of competitive mass production -- whether it be by conveyor systems, fork trucks, pallet jacks, dollies or whatever else is needed to keep materials moving within a plant. As for warehousing, we recognize that good materials handling not only means making the most of the cubic area available, it means knowing where materials are when you want them, and being in a position to support either manufacturing or supply in the shortest possible time, at the lowest possible cost.

Now originally, the concern of the manufacturer began at the receiving dock of his factory and ended at the shipping platform, including the need to conform to freight classification requirements. Today, equal consideration must be given to materials handling before and beyond this stage. One reason is the fact that certain warehousing and manufacturing problems are the result of packaging inadequately designed for handling by plants or warehouses to which the goods are shipped. As a result, many customers now specify packaging designed for use in high-speed production and improved materials handling in their plants. I appreciate, of course, that the interest of the armed services on this point may be secondary in some respects; but it does become a matter of prime concern to them in the proper utilization of warehouse space and where goods are trans-shipped from larger to

smaller military depots, and then to still smaller ones. Whether or not they directly participate in the process, anything that facilitates and speeds the delivery of equipment made under contract is very much the interest of the services.

This last point is where the interests of packaging and materials handling directly converge -- where the size, the shape and the weight of the package have an immediate bearing on the ease and economy with which it can be fitted into a production or distribution system. For example, most of us will agree that packages in excess of seventy pounds are difficult for one man to handle manually. When packages do go beyond a certain size and weight, features should be incorporated in the package design which will facilitate handling; a skid, for example, at the bottom of a large wooden box. But whatever the method, the important thing to remember is the direct working inter-relationship between the two -- packaging and materials handling.

I have tried to mention a few instances of the problems in this entire field with which we are concerned. The details, however, I shall leave to the very able experts who will be conducting the various talks and conferences of the next three days; but I do want to comment briefly on the meaning of this symposium and the field it covers.

The very fact that this symposium was called and that it is so well attended is indicative o. the increasing recognition of the importance of packaging and materials handling, both to industry and the Armed Forces. There is a growing understanding by management of the fact that the product alone is not the complete answer. How it gets to its destination, how quickly, what it looks like, how easily it can be used -- these are the considerations gaining in importance.

This process needs further strengthening, not only through meetingssuch asthis between two broad groups, but on a day-to-day basis within the groups themselves -- in other words, in the working relationship between these responsible for planning and direction and the experts concerned with packaging and materials handling.

There is another aspect of this symposium which strikes me as significant, and that is the benefits that both of us derive from such an exchange. Largely as a result of World War II, both we in industry and you in the armed services are engaged in operations on a scale that neither of us could have possibly foreseen two decades ago. In many respects we

face many of the same problems and are seeking many of the same answers. It is interesting to note the balance in this symposium between experts from the services and those from civilian life. In drawing on each other's experience, as we are doing here, both of us will gain tremendously.

It is, of course, essential that we do so. Apart from our own particular interests, there is one point at which we must have the most intimate coordination and that is where we meet with you on matters of military procurement. Here, above all, let us be frank even though the process may appear painful at times. We, in industry, have sometimes complained of the rigidities of your procurement system, particularly with regard to specifications. It is difficult for us to understand, for example, why standardization and simplification are so difficult to achieve, even where the advantages in cost and production may be considerable. On the other hand, I suspect that most of us are only dimly aware of the reasons behind many of the requirements set down by the armed services as well as all the uses to which equipment may be put. This lack of knowledge may be the reason for what, to you, appears to be our unreasonableness. As contractors for the Armed Forces may I say, then, that if we in industry knew more about your problems and your thinking, I am certain that we could do a far more effective job for you. But I also feel that you in the military services stand much to gain from our experience in fulfilling the stern demands of competitive free enterprise. And, so together, we must approach this relationship in a spirit of full and open frankness -- with flexibility and a willingness to re-evaluate old concepts in the light of new knowledge; above all with an appreciation of the fact that both of us are working toward the same goals.

Finally, I see this symposium as the beginning rather than the high point of our working relationship. This field of packaging and materialshandling is dynamic. It is constantly changing, always growing. Ideas and methods discussed in this building during the next three days may be outdated or superseded a year from now. Savings and efficiencies considered impossibilities today may be working realities tomorrow. And so we cannot consider our job completed when we ring the curtain down on the final session this Wednesday. We must come back to the subject again and again because that is the only sure guarantee of continuing progress. I think I speak for industry when I say that for our part we are ready and eager to do so.

Monday AM Oct. 10, 1955

Planning Military Transportation Today

Major General B. F. Hayford
Deputy Chief of Transportation, USA

The subject assigned to me is broad, complex and to a degree highly technical. Planning military transportation today is a subject too extensive to be adequately treated in one lecture. I have no intention of doing it nor do I intend to bore you with a discussion of the technique of planning. I am mindful of the purpose of this conference and of the field of interest of the participants. So I shall limit my talk to those elements of the Army's planning which I believe are of interest to you, and which can be profitably discussed in the later and less formal sessions of this symposium.

In the interest of brevity, I shall pass over very lightly the problems of peace-time operation. If we solve the war-time problems, we have solved the most difficult ones. Further, since our job is to be prepared at all times to take up the defense of our country, our peace-time equipment, organization and methods must be of such a nature as to facilitate an immediate, practically instantaneous, transition to war-time operations. Operations in which the lives of thousands of men and women will depend upon the effectiveness of our operations rather than the dollar and cents economy. Unfortunately this axiomatic principal is too frequently forgotten by people both within and without the military establishment. The soldier who needed ammunition last week or the surgeon who needed biologicals ten days ago can hardly be consoled by the explanation that the delay saved 10% in transportation costs.

Another very important fact to be remembered is that the transportation job is not just an Army problem, not even if we restrict our area of consideration to the transportation of the Army's supplies. The job must be accomplished through complete cooperation of all three services and the industry. Although I shall focus my talk on the Army's sphere of activity, I hope you will not forget that the Army could not possibly fulfill its transportation mission without the full support of the Navy and its Military Sea Transportation Service and the Air Force and its Military Air Transportation Service and the industry.

The pattern of my talk is this. First, a description of our war-time mission or task with emphasis on the peculiar conditions under which it must be accomplished. Secondly, what we have done and are doing to solve the problems. I hope that what I say now will stimulate a lively and beneficial

exchange of ideas during the later sessions of this symposium.

What is the problem? Simply stated it is this.

1. Transporting men and their equipment to and from their training areas and to the area of operations.

2. Transporting to the area of operations the supplies and maintenance equipment to support them.

3. Shifting forces and their logistical support from one area of activity to another with the speed and effectiveness demanded by warfare in the atomic air age.

Some elements of this problem are not pertinent to this symposium. Movements of personnel and the shipment of bulk cargoes are the elements in point. Bulk fuels make up approximately 50% of the tonnage to be moved. My omission of further discussion of these elements in no way implies unimportance or ease of handling but rather an effort to limit discussion to those cargoes which present problems in packaging and the use of materials handling equipment. The cargo which I wish to discuss now include wheeled and tracked vehicles (which make up almost half), many bulky items of equipment such asradars, ammunition and other hazardous cargo, delicate electronic and surgical equipment, perishable biologicals for medical purposes, food, plain general cargoes and lastly cargoes which for reasons of secrecy must be carefully guarded. Each type presents its peculiar problems in handling.

What is the Magnitude of the Problem?

For purpose of illustration let us assume that a force of a million men is to be transported to an over-seas area and supported there. The equipment which would accompany the force who average about 2 1/3 short tons per man which, for our hypothetical force, would total over 2,300,000 short tons. It would fill over 116,000 freight cars for the land haul and about 460 conventional ocean-going ships for the sea haul. For every man in the over-seas area 2/3 of a short ton of cargo would be need each month to maintain him. For our hypothetical force this monthly maintenance totals 660,000 tons - enough to fill 31,000 freight cars or 121 ocean freighters.

Remember this is only part of the total task; this does not include bulk cargoes or personnel. It does not make any provision for aid to indigenous civilian populations. By World War II standards, a force of one million men is not excessive.

Maj. Gen. B. F. Hayford Monday AM Oct. 10, 1955

Under What Conditions Can We Expect to be doing this Job?

Since the problems at the far shore, closer to the foe, will be more difficult than loading the cargo on ships or planes in the U.S., let us assume that the cargo is loaded out without presenting insurmountable problems to the Army. Transporting the cargoes to the far shore or air field is the problem of the Military Sea Transportation Service or the Military Air Transportation Service. The Army's real problems begin when the carrier arrives in the target area.

Landing on a hostile shore against opposition is a highly specialized and extremely difficult operation but it involves few problems pertinent to this conference. This discussion of the follow-up operations of supporting forces established ashore or the supporting of forces over friendly shores in the area of operations would be more profitable for this group. I shall so limit my further discussions.

We must be prepared to operate anywhere from Arctic wastes to tropical steaming jungle; through fine ports, secondary ports or fishing villages, over sandy beaches, tidal flats or rocky shores.

During the last war we frequently were able to take advantage of an existing or rebuilt port complex within a relatively short time after an attack began and thereafter pour our cargo through such facilities. In other areas we were able to build good harbor facilities. In a future war in this age of long range air power, guided missiles and atomic bombs, we may be forced to use open beaches, minor ports and undeveloped areas through all stages of a campaign. We can no longer risk massing large numbers of ocean vessels at anchor or at wharves and piers, nor can we risk huge concentrations of valuable cargoes at any point. It will be unsafe to utilize the most desirable ports to their maximum capacity as we did in the past. One or two ships at a time, widely dispersed will be the rule and we must move them into and out of a target zone as rapidly as possible. We cannot permit a large port crowded with ships to be exposed to enemy long range action.

The tremendous mobility and terrific striking power of today's combat forces will bring about extremely sudden changes in the tactical and strategic situation. This will require a highly flexible transportation system which will be capable of shifting its efforts rapidly and effectively from one area to another. We cannot allow a rigid transportation system to restrict the combat forces.

In general our transportation plans are therefore being drawn up within the framework of five major objectives.

1. To obtain greater speed and flexibility of movement.

2. To disperse transportation media and facilities to the extent necessary for safety.

3. To conserve manpower to the utmost.

4. To conserve supplies and equipment for a possible "long pull."

5. To stand prepared for any type of an emergency, large or small, that may occur anywhere in the world.

How do we plan to solve our problems?

One of the large classes of commodities to be moved consists of tracked and wheeled weapons and vehicles. Such items traditionally have been transported aboard conventional ocean vessels either below deck or lashed on deck. We consider such methods too costly in time, money and manpower. More serious is the long time such a vessel must remain in the target area to unload. One answer seems to lie in some kind of ship of special design which will permit these vehicles to be rolled on and off on their own wheels or tracks ready for use with a minimum of servicing. Vehicles loaded aboard such vessels could themselves carry cargo in a manner similar to a car or train ferry. We have adopted a term "roll-on-roll-off" to designate vessels of this type. Studies recently made by the Transportation Corps indicate that had such roll-on-roll-off ship been used in past war years on the New York - Bremerhaven run instead of the conventional cargo ships, time in port and handling costs could have been cut to one-third.

A study of the overseas movement of ammunition during the Korean emergency concluded that had ammunition been loaded in freight cars and these cars moved overseas in car ferries of either the roll-on-roll-off type or the lift-on type ships, a saving of several million dollars in handling cost could have been achieved and the supply cycle could have been reduced by 23½ days or 41.6%.

Several commercial operators are taking an increased interest in the advantages of this type vessel for particular operations. We expect to see several such vessels in commercial service in the near future and MSTS is constructing such a vessel to meet the Army's peculiar needs.

Roll-on-roll-off type ocean going vessels will not be able to discharge their loads of vehicles over beaches. Some means must be provided to transport the vehicles from the deep water anchorage to the beach. Our answer to that is a 300-foot self propelled beach lighter onto which the vehicles can be rolled directly from the ship. The lighter can then proceed to shore and discharge them on to the beach over a self-contained ramp. It will be large enough to carry several of the largest vehicles and tanks. It will be propelled by two cycloidal propellers which will be capable of holding the lighter in position on a beach under practically all conditions of tide and current. It will be capable of operating with conventional ships with equal effectiveness.

The roll-on-roll-off type vessel admittedly is a specialized vessel. Although several commercial operators soon will be using vessels of this type, we cannot expect them to fully replace the more conventional cargo ships. So we are improving our fleet of lighterage craft which will be the link between these conventional vessels and the beach or shallow water piers.

The Transportation Corps is assisting in the development of a new fleet of landing craft, harbor craft and similar vessels. The LCM (6) (Landing Craft Mechanized) of World War II fame has been improved by design changes and certain mechanical improvements. A new Landing Craft Mechanized, the LCM (8) has now been added to the fleet. It is a larger craft with increased cargo carrying capacity. This vessel is designed to lift any item of equipment organic to an infantry division. Its cargo well and bow ramp are sufficient to accommodate the 60 ton tank. The LCU (Landing Craft Utility) has also been modified with a number of design changes.

As useful as these floating craft are they possess two undesirable characteristics. First, a safe haven must be available for their protection during storms. Second, and more important, the cargo they carry must be transferred to another vehicle at the water's edge, an awkward and labor consuming job in an exposed target area. Both of these disadvantages can be overcome by the use of amphibious craft.

The most familiar as well as the smallest of our wheeled amphibians is the World War II DUKW. This was a famous piece of amphibious equipment but it has outlived its usefulness because of its small cargo capacity. It will be obsolete as soon as new and larger amphibians are produced in quantity. One of the newer amphibians is the 2½ to 4 ton Superdukw which has greater cargo capacity than its predecessor but with very little change in its overall dimensions. Loaded, this

amphibian has a land speed of 50 MPH and a water speed of 7 knots. It has a unique arrangement for control wherein the propellors have a dual function of power and steering. No rudders are used.

Still larger than the Superdukw is the 8-10 ton DRAKE, which not only can carry larger loads but is so constructed as to permit the use of standard automotive parts similar to the DUKW and Superdukw. It thus has the advantage of economy in manufacture and interchangeability of parts. It has a land speed of 42 MPH and water speed is up to 10 knots. This is the smallest wheeled amphibian equipped with a ramp, located in the rear.

Largest of all the new wheeled amphibians is the BARC, or, to use its long title, the BARGE, AMPHIBIOUS, RESUPPLY CARGO. This is in reality an amphibious barge and is able to carry cargo from ship to shore and across the beach with payloads of up to 60 tons. Tires over 9 feet high reduce ground pressure for movement over soft sand or sharp coral. The BARC's four wheels are each independently powered by a 165 HP Diesel engine. When water borne the BARC is propelled by twin screws. Empty, the vessel has a land speed of 15 MPH and sea speed of 6.6 knots. Loaded the land speed is 10 MPH and sea speed of 6.1 knots.

As soon as possible piers or wharves of various kinds will be constructed and means provided for the expeditious movement of cargo further inland. The floating pontoon pier and causeway made up of pontoon cells that was widely used in World War II will have much practical use again. In recent years various designs of spud barges have come into being. These we believe will provide us with the answer to some of our dock problems. Spud barges are steel barges of various types, sizes and characteristics. When ready for installation steel caissons are dropped through wells located along the outer edges of the long axis of the barge. The caissons are then driven to the required penetration. The barge is elevated on the caissons until the desired elevation has been attained. In such a manner a pier of practically any desired size may be erected in a few days. Spud barges are capable of being dismantled and may be moved and re-erected at a new site. The Transportation Corps now has spud barges in active operation in Whittier, Alaska and Thule, Greenland as permanent structures.

The Aerial Tramway is a useful means of moving cargo inland particularly where adverse terrain conditions make transportation by simpler means impractical. Our present aerial tramway consists of two cable tracks supported on a series of towers. The cable extends for about one mile but can be lengthened with equivalent units. Suspended from the cables are four cargo cars with a tonnage capability of

about 1440 short tons per day.

This cable-way can be used in conjunction with a spud type pier as a means of moving cargo from a deep water berth off shore to a suitable site inland. It is particularly advantageous in areas where the shore line otherwise would be difficult or impossible to traverse. The transporting medium is a spud barge capable of being towed overseas and of sufficient size to accommodate the entire system knocked down. Upon erection the spud barge serves as the seaward terminal of the system to which ocean cargo vessels can be berthed for discharge or reloading.

Other important items of shoreside equipment include newly designed rough terrain fork lift trucks, rough terrain cranes and powered overland conveyors. The rough terrain fork lift trucks and cranes make possible the handling of cargo from landing craft or amphibious vehicles and moving the loads over sandy marshy or steep terrains at present completely beyond the scope of conventional equipment of this type. They are essential for the handling of unitized cargo about which I shall speak later. Cargo can thus be quickly transferred to over-the-road or rail equipment with a minimum of man-power.

Overland conveyors, as the name implies, will permit the continuous movement of cargo over a system of endless belts and transfer tables with branches and stations. These endless belt conveyors will be capable of traversing almost any kind of adverse land forms with a minimum of difficulty. They are built in sections, each with its own power, which can be assembled into any desired system.

More and more freight is being transported by air and we will strive to achieve complete air transportability of all of our materiel in the not too distant future. Although the long hauls will be flown by the Air Force, the Army also is developing a number of cargo helicopters capable of lifting moderately heavy loads for short distances. This opens up a whole new complex of logistical support concepts. The exact form, substance and full capabilities of the new techniques has yet to be realized.

Much time and manpower has been consumed in the past in the man-handling of a multitude of relatively small packages. In an effort to eliminate this waste, we have analyzed the entire content of the Army Supply System and have learned that fully 50% of the general cargo consists of relatively small packages. In this group we find ammunition, food, clothing, electrical equipment, medical supplies and thousands

of items of spare parts. In the past we have literally moved mountains and mountains of these items, piece by piece into and out of every form of transportation equipment; not once or twice but often dozens of times. Whenever cargo is handled, costs mount, labor is wasted, delays occur and goods are exposed to loss and damage. The overwhelming burden of doing this job by outmoded if not ancient methods has become far too expensive for us to continue to tolerate. We decided to do something about it, not only in future logistical planning but in current operations as well.

Instead of manhandling each package at each transshipment point, we are now assembling small package shipments into unit loads of optimum size for the direct application of mechanical handling equipment with a minimum of human effort. We call this "unitization". It is now being done by two methods; by banding and bonding packages onto pallets and preserving the integrity of the pallet loads from origin to destination and by carrying packages in large reusable steel shipping boxes or containers. Our goal is to unitize about 42% of dry cargo. The steel shipping container we call a Cargo Transporter and the service is known by the short title CONEX. The box itself will carry 9000 lbs. of freight in 295 cubic feet and is particularly adapted for cargo weighing up to 30 lbs. per cubic foot. Our cargo transporters are operated as a single fleet jointly with the U. S. Air Force through a system of centralized control in the Office of the Chief of Transportation. By the end of this year the fleet size will reach 17,500 and more are on order for 1956. Although the Cargo Transporter has been in service only a relatively short time, it has already chalked up sizeable gains in reduced packaging requirements; greater protection from weather, theft and pilferage; faster loading and unloading and considerable reduction in the manpower required for handling, checking and documentation.

In time of emergency, the steel cargo transporter can be used for storage in the open affording adequate protection from weather and ressonable accessibility to the contents. This feature should greatly reduce the amount of construction required in over-sea areas. Also, the transporters with their contents are always ready for prompt movement to satisfy sudden demands.

These are some of our plans for military transportation in the future. It is not a complete description, nor is it conclusive. We will never cease to learn and develop better methods and better equipment. The ultimate success of this entire program is contingent in no small measure on the degree of close cooperation and mutual understanding that can be realized between the industry and the Armed Forces. This joint symposium on packaging and materials handling is a prime

example of the very kind of activity that is most likely to achieve the desirable results.

Our offices are always open to you and we always welcome a man with a suggestion on how we can do it better.

Replenishment at Sea

Vice Admiral R. P. Briscoe
Deputy Chief of Naval Operations
(Fleet Operations and Readiness)

The naval striking force is a unique weapon which has no parallel in warfare. It combines great destructive power with extreme flexibility and mobility. A task force made up of heavy combatant ships - - battleships and cruisers - - together with the necessary screening destroyers, can destroy coastal installations along hostile shorelines, support amphibious landings on the enemy's beaches, and sweep enemy shipping from the seas; fast carrier task forces, operating offshore, can launch air strikes, armed with a great variety of weapons, to attack vital targets deep within enemy territory. But - - powerful as the naval striking force might be, its inherent ability to stay at sea is limited by the amounts of fuel, ammunition and stores that the ships can carry on board.

It is not hard to understand that intensive operations will result in the expenditure of large amounts of fuel and ammunition. Minor battle damage can cause casualties to hull and machinery which will require replacement parts for emergency repairs. Supplies in all categories must be taken aboard and aircraft and aircrews must be replaced and relieved. Thus, after each period of intensive operations, there must come a replenishment phase. Of all the replenishment categories in terms of tonnage it is accepted that fuel and ammunition are the determining factors in measuring the ability of a striking force to stay at sea.

In order to add endurance to the other favorable attributes of the striking force, the Navy has developed the method of mobile logistic support, which provides the fighting fleet with the essential means for continuing naval warfare. The flow of such support is via the mobile support group, augmented as necessary by advanced bases, to the ultimate delivery agent - - the underway replenishment group. This group is essentially a mobile supply depot, armed for its own defense, which remains on the outer fringes of the fighting area, ready at any time to deliver the means of war to forces afloat.

Without mobile logistic support a striking force would be required to return to the nearest base of replenishment after each period of intensive operations. Under these conditions offensive operations would be limited largely to hit-and-run tactics, with precious time wasted in steaming between the objective area and the replenishment base. But when full

mobile logistic support is available, the striking force is freed of its major logistic limitation, and is thus able to exert intense and continuous pressure on the enemy, even though they may be thousands of miles from permanent replenishment bases. In 1945, during the later days of World War II, the Fifth Fleet was able to remain continuously at sea for 89 days, giving support and cover to land forces engaged at Okinawa. This was accomplished through a complex of advanced bases, mobile support groups and underway replenishment activities with the nearest major base at Ulithi, 1200 miles away. During the more recent Korean operations the carrier striking force, Task Force 77, stayed on the bomb line and carried out round-the-clock bombing by the use of replenishment-at-sea methods. The Sixth Fleet in the Mediterranean Sea, with no fixed base, is supplied from continental U. S. bases by mobile support and underway replenishment groups. It has become increasingly evident that when a naval force engages in prolonged operations far from its bases of supply, its powers of endurance, disregarding battle casualties or other major mishaps and the human factors involved, are limited only by the extent of the mobile logistic support which is made available.

The underway replenishment group is a task group made up of fleet auxiliaries, together with appropriate screening and protective ships. The basic auxiliary types in use today are the fleet oiler, the ammunition ship, the refrigerated store ship and the general stores issue ship. Certain specialized auxiliary types, such as replenishment carriers, ocean tugs and a hospital ship may be included in a replenishment group if the need is indicated. The screening ships will be destroyer types capable of anti-submarine and air defense operations. The heavy protective ships may include cruisers and a combatant carrier.

The ultimate organization of an underway replenishment group is determined by the size and composition of the force to be supported, as well as by the type of operations which the supported force may be expected to undertake. In addition to the routine tasks of supplying fuel, ammunition, replacement aircraft and aircrews, provisions, general stores and technical spare parts, the underway replenishment group may also provide special services such as towing, limited salvage, technical assistance, mail, and medical support. An underway replenishment group will normally be prepared to provide supplies and services sufficient to maintain the supported force for continuous operations at sea for a maximum period of about 90 days.

The major portion of our auxiliary ships at the present

time are World War II types. The fleet oilers are generally of the Maritime Commission type T-2 and T-3 tankers, with additional equipment and rigging added as necessary to give them the capability of transferring petroleum products while underway in the open sea. These ships are capable of transporting about 16,000 tons of fuel oil and about 600,000 gallons of gasoline as their primary cargo. Several of the oilers have been converted to serve primarily as gasoline filling stations for carriers, and carry about twice the amount of gasoline with a corresponding reduction in their black oil cargo capacity. The oilers are all in the neighborhood of 530 feet long with a beam of 7 feet and a full load displacement of about 23,000 tons. These oilers are rigged to replenish ships simultaneously from both sides, the usual practice being to take the carriers and other heavy ships on the port side and the destroyer types on the starboard side. The pumping rate for the older tankers is approximately 360,000 gallons of fuel oil per hour and about 100,000 gallons of gasoline per hour. The oilers are also equipped for high line transfer of such items as lube oil in drums, bottled gases, movie programs, mail and high priority fleet freight.

A new class of fleet oiler is now being introduced into the fleet. These new ships are larger, faster, and have greater cargo carrying capacities and higher transfer rate capabilities than the existing fleet oilers. Four of these ships have been completed and will be fully operational in the Fleet this year.

The ammunition ships are basically Maritime Commission type C-2 cargo hulls. Their cargo capacity is approximately 6000 to 7000 tons with a full load displacement of about 14,000 tons. These ships are rigged to replenish ships along both sides from three stations on each side. The transfer gear of the ships is capable of handling any of the weapons which our naval air and surface forces are equipped to employ at the present time. The maximum unit load which can be transferred between the ammunition ship and a ship steaming alongside is in excess of 5 tons. This is possible only under favorable weather conditions and requires close station keeping. Each ammunition ship normally is equipped with one rig, usable on either side which can handle up to 3 tons, and the remaining stations can handle about 1½ tons to heavy ships and about ½ ton to destroyer types and other escorts. All of these latter are "all weather" rigs.

In the field of ammunition ships, a new design has been completed and two of the new ships are presently under construction. The new class will be slightly larger and faster than present ships, and will incorporate major improvements to stowage and handling arrangements for the cargo ammunition.

Our refrigerated cargo ships are a variety of Maritime Commission hulls of the C-1, C-2, R-1, R-2 and VC types. These ships average about 14,000 tons displacement and have anywhere from 130,000 to 350,000 cubic feet of refrigerated cargo space. They are rigged similar to the ammunition ships, capable of replenishing a ship along each side from not more than six stations simultaneously. The maximum load which can be transferred is about 3 tons, with the normal load being about 1½ tons to heavy ships and ½ ton to escort types. The design for a new construction refrigerated cargo ship has been completed and two ships are now under construction. Like the new ammunition ships, the new reefers will have greatly improved facilities for stowage, breakout and handling of cargo.

The general cargo replenishment ships are similar in size, configuration and rigging to the ammunition ships and the refrigerated cargo ships, with the exception that they do not have the specialized ammunition handling equipment or the refrigerated cargo spaces of the other types. Their transfer capabilities are similar to those of the reefers.

In addition to the replenishment types discussed here, all major combatant ships - - carriers, battleships and cruisers - - are equipped with limited capabilities for replenishing escorts with fuel and emergency supplies, and all ships are equipped to transfer movie programs, mail, light freight and personnel.

The actual mechanics of the replenishment at sea operation have been time tested and proven over a period of about 15 years. In the early days of World War II, the capability for replenishment at sea became an urgent necessity. At that time, both techniques and rigs were crude, inefficient and dangerous. A transfer at sea was a difficult and a dangerous project. The ship making the approach came in as close alongside as he dared and p a line across by some means. Then the line was secured at one end to the nearest fitting or structure which appeared heavy enough to support the load, and with men tailing out on the free end, the transfer of, at best, a few hundred pounds took place. Fueling at sea was much the same. The four inch hose was hauled across by manpower and, with the sea between the ships snatching at it continuously, the end was brought aboard and secured and the pumping commenced. Barring casualties to hose or gear, several hours later the receiving ship was able to go about his business with full tanks. Neither rigs nor procedures were standardized. Each ship, replenishment and combatant, could be expected to have his own variations. Obviously, this was a bad situation.

So, the designers and the seagoing men got together to correct the discrepancies. By the time 1944 came along, there were type plans for replenishment at sea gear as well as instructions on procedure for most combatant ships and replenishment ships then in service. True, due to lack of overhaul time, the installation of the gear was far behind the planning, but ships were able to improvise along the lines indicated by the type plans, so that replenishment became a standardized, routine evolution rather than a hazardous undertaking which taxed the ingenuity of all hands involved.

The development of equipment, rigging, and techniques has continued. During the Korean operations, our ability to replenish at sea received a severe test. The Seventh Fleet was kept at sea for long periods with all replenishment done at sea. Under pressure of heavy operating schedules and unfavorable weather conditions, the replenishment at sea operations reached their highest efficiency. The rates of delivery of both liquids and solids were increased to previously unheard of figures, with corresponding reduction of times alongside - - a reduction of the times when the ships cannot maneuver radically, when gun batteries are masked, in short - - when the ship is extremely vulnerable to air attack. Here are some figures on the rates of transfer during that period. Fuel oil was delivered to heavy ships at rates consistently greater than 160,000 gallons per hour and to destroyer types at rates greater than 100,000 gallons per hour. Ammunition ships reached rates of delivery of greater than 100 short tons per hour to heavy ships and greater than 20 short tons per hour to destroyer types. The refrigerator ships were able to transfer between 60 and 30 short tons per hour to heavy ships and better than 20 short tons per hour to destroyer types.

The Navy now has a firm doctrine for both tactics and technique for replenishing at sea. Basically, for a replenishment operation, the replenishment group is formed in several columns on an appropriate course and at an appropriate speed, and with ample spacing between ships to permit safe maneuvering of the combatants approaching and leaving their sides. The requirements of the combatants for fuel, ammunition, supplies and provisions will normally have been submitted by dispatch prior to the rendezvous with the replenishment group, and the over-all commander of the replenishment operation will have promulgated a schedule for all combatants to go alongside the necessary replenishment types to satisfy their needs. When the rendezvous is effected, the combatant group and the replenishment group combine into one formation. The first ships scheduled alongside take station astern of their assigned replenishment ships and the screen destroyers not assigned to lifeguard duties astern of replenishing ships, combine with the replenish-

ment group screen. Then, on signal from the officer in tactical command, the operation commences. The screen is adjusted from time to time to permit the screen ships to meet their schedules alongside the replenishment ships.

Fueling is accomplished by means of the span wire method, in which the hose between the ships is supported on a span wire, one end of which is secured on the receiving ship. The other end is passed through a block at a boom head and kept taut by a winch on the delivering ship. There are three basic methods in use for transfer of solids. The burtoning method, which is capable of handling the heaviest loads, requires the use of a winch or crane on each ship. The load is supported by the two whips, and as the delivering ship slacks off, the receiving ship hauls in on his whip, thus hauling the load across. The housefall method is similar to the burtoning method with the exception that the whip is not tended on the receiving ship, but is run through a heavy block and led back to the delivering ship, where both ends are tended by winches. The third method is the highline in which one end is secured on the receiving ship and the line is kept taut by means of a winch or manpower on the delivering ship. The load is then suspended from a trolley and hauled across by means of a smaller line to the receiving ship. The highline may be of wire or manila except that for personnel transfer, it must be manila and it must be tended by manpower.

Our efforts to improve our capabilities for replenishment at sea <u>in any weather</u> are continuing without abatement. A method for refueling escorts at greater distances from the delivering ship has recently been evaluated in sea states which would make it impossible to stay alongside using conventional methods. Work is continuing on a device which will maintain a constant tension on a line between ships, regardless of the motion of the ships. This will relieve the problem of maintaining the line taut by means of a manually operated winch, and will facilitate replenishment under unfavorable sea conditions.

Improvements to materials handling equipment and packaging are also major factors in our search for increased proficiency. The Bureau of Supplies and Accounts has done much on the development of equipment for handling supplies on both supply ships and combatants. Devices such as portable elevators and conveyors, special chutes for vertical drops, improved slings and nets and better pallets have been developed and are under evaluation. The problem of packaging presents a challenge to the industry. To increase the "pay load," containers must be light in weight, but the winchman who is

handling the load and the blue jackets on the receiving ship may not always have the "gentle touch." So the containers must also have the necessary strength to withstand the rigors of the breakout, the transfer, and the strikedown. Light weight, strength, and the all important factor of economical production is a combination that will take a bit of thought. Special problems such as shock proofing of sensitive equipment within its container and waterproofing of containers against the entry of sea water while being transferred just tend to make the whole picture more interesting.

The Bureau of Ships has made surveys on ammunition handling and has developed special electric trucks and elevators and a new type of portable dunnage for use in ammunition ships. The introduction of guided missiles into the fleet presents a new problem of stowage and handling in ammunition ships. This problem too, is well on it's way to solution. Our new fleet oilers, as has been mentioned previously, have greatly increased pumping rates. A new lightweight fuel hose is now being evaluated for possible use in the Fleet.

Mobile logistic support and replenishment at sea are here to stay. The Navy has developed replenishment at sea into a science, and the development is continuing. It is the lifeline of the Navy and it must be ready when needed.

In order to give you an idea of the problems involved and the conditions under which we are presently engaged in replenishing at sea, I have a short movie which I would like to show at this time to conclude my remarks.

Monday AM Oct. 10, 1955

"An Essential Element of Air Power"

Maj General John P. Doyle
Director of Transportation, Headquarters, USAF

Gentlemen, every day the newspapers emphasize the global mission of the Air Force. If you read of an election in Japan, someone will mention that the Fifth Air Force is over there. Let a volcano blow off in Alaska and we hear of Ladd and Elmendorf Air Bases. The newspapers this summer have been full of the distant early warning line which is that string of stations across the northern part of the American continent.

A couple of years ago LIFE magazine devoted an entire article, practically an entire issue, to the air base at Thule, Greenland. Right now there are political difficulties in Morocco and they emphasize the fact that we have bases there. And so it goes, with Spain, with France, with England, with Germany, Saudi Arabia and so on all around the world. Our Air Force is globally deployed.

What are some of the applications of air power? Many of them are absolutely essential to the operation of the Strategic Air Command. Combat organizations that use air transport move with the speed of modern aircraft. These organizations all need logistic support, and that logistic support must then have equal mobility. If it does not, then the organization that is supposed to take care of the support mission will only be partially effective. I think it is self-evident that mobility is essential to the application of air power, and it is impossible to visualize mobility in an air age which does not exploit to the maximum, the use of air transport.

However, it is impossible to obtain maximum utilization of air transport when we lack a real system for handling air cargo. Now to some degree, other modes of transport have attempted to integrate the terminals, the vehicles, the materials handling and the packaging into a whole, but in general the aviation industry has not accomplished this. In our own military air transport service, which has probably spent more time on this than any organization in the country, we can get a planeload of cargo onto the plane in about eight minutes, but it still takes nineteen minutes to tie that cargo down securely.

This symposium is to deal principally with packaging and materials handling. These are certainly important aspects of the problem, but we do not believe that these components can be discussed as though they were independent of the whole, when actually they should be integrated into a complete handling system.

The development of a handling system that we have in mind must consider the size and shape of the cargo compartment, the size and

location of cargo doors, the strength of floors and the type and pattern of cargo tie-down equipment. Cargo handling equipment must be integrated in the vehicle and terminal design. The terminal design must be compatible with types of aircraft in the system and all other modes of transportation. Size, shape and density of unit loads and the type of packaging must be considered. Our handling system must accept current vehicles and facilities, but it must be capable of expansion and development consistent with the vehicles that are now coming out or that will be built in the future. To develop such a system is not going to be an easy task.

Perhaps a module like the four-inch cube that the architects use can be a tool. Maybe around that we can build or design our handling system to permit interchangeability with other modes of transport and permit interchangeability between the services and with commercial activities.

The Wall Street Journal of the 23d of September indicates a gain of 25 percent on trans-Atlantic air cargo and 23 percent on domestic air cargo for 1955. It is significant within the domestic cargo field that the all-cargo carrier gained 30 percent as opposed to only 20 percent for the combination carrier. Trends such as these cannot be ignored.

Manufacturers and carriers alike must look ahead to the day of the all-cargo airplane. With such developments will come a realization that there must be a tight correlation between the cargo compartment and the size, composition and handling methods of the packages going into it.

The air freight industry is still just a baby. We have an opportunity to develop a handling system such as I have mentioned and to develop it to the mutual benefit of both industry and the military departments. Now, this is going to require a vast amount of coordination. In order to effect that coordination, we need a common point of information exchange, sort of a system engineering clearing house. We think that the clearing house should be primarily civilian with service participation. We think it must be capable of providing all of the necessary technical skills, that we can call upon when necessary to the development of such a system, and we think it can only be operated by some non-profit organization that does not have a personal axe to grind.

National Defense, gentlemen, is a full time job for all of us. Transportation is closely tied to defense and to our national economy. Let's not have future historians say we have built an unintegrated air transport system which dissipates, as it does to a great extent today, the true value of

the airplane as a vehicle by permitting excessive ground delays and the lack of maximum utilization of cargo space.

If we can build such an integrated cargo handling system, we will increase our military mobility through the application of air power and we will at the same time increase our civilian profit.

"Research and Development--Keeping Ahead of Military Operational Needs"

Rear Admiral F. R. Furth, USN

Chief of Naval Research

One of the results of research and development is the necessity to perform more research. It is axiomatic in science that whenever you make an important breakthrough, you usually open up a whole new host of problems to be solved. This is certainly true of military research and development. The application of scientific research to military weaponry has brought advances during the past 15 years that dwarf all the progress made up to that time. It has greatly changed military operations, and each new weapon has brought with it a school of corollary problems that had to be solved.

More is involved here than the traditional military see-saw between weapons and coutermeasures, in which you increase the range of your submarines, for example, then realize you must immediately increase the sensitivity of your sonar detection gear, because you assume the enemy can improve his submarines, too. The corollary problems are those that crop up because the new weapon changes your supply problem, it may increase your personnel training problem, or pose new technical problems.

One recent major technological breakthrough has been the application of nuclear power to submarines. The success of this program brought in its wake new problems of undersea navigation and psychological problems associated with the reactions of a crew in a boat submerged possibly for months on end. Research and development must anticipate these problems, and keep abreast of them.

The military services are now in a period where many of the scientific and technological breakthroughs of the post-war period have begun to reach the operating forces in the form of drastically different new weapons and equipments. It is no exaggeration to say that we are in a state of foment, in which operating procedures and tactics are being revised to keep pace with advances in weaponry. In general, the speed and complexity of operations has been stepped up.

Consider some of the major advances in naval warfare: Supersonic jet aircraft will soon operate from the decks

of our carriers. A renaissance for seaplanes appears to be underway, heralded by the new jet-powered SEA MASTER, a large, fast minelayer. Guided missiles have entered the Fleet, for anti-aircraft fire and shore bombardment. Nuclear-powered submarines are a reality. The range and speed of naval operations in the air, on the surface and beneath the sea, is being drastically stepped up, and as our capabilities are increased we must accept a greater premium on speed and precision in all of our supporting operations.

A greater variety of supplies and equipments must flow to the operating forces to meet their needs, and it must move through the supply system with more speed than before. As a research organization, it is the job of the Office of Naval Research to lay the foundations for new techniques of supply and new kinds of equipment to improve the process. It is not enough to set out to solve problems as they arise in the Fleet; it is not even enough to anticipate problems. If we intend to keep ahead of operational needs, we must systematically examine the fundamental working principles of our operations, to find out if the assumptions we have always taken for granted are really true.

The whole field of logistics is being formally studied to find out more about the principles which govern the production and distribution of goods in modern military operations. One principal aim of this work is the introduction of objective planning factors to replace guesswork in computing initial requirements and resupply shipping requirements for any operation. Logistics research includes research and development on new and improved mathematical methods and computing equipment for carrying out the statistical and administrative activities involved in military logistics planning. A special purpose electronic digital computer, designed specifically for use in logistics computations, is now in operation as a part of this research.

This work is supporting research. It helps to develop the techniques which can be used to solve specific operating problems, and to design equipments for the best possible performance of a certain job. It is concerned with finding out what the true problems are, then analyzing them for solution.

One important phase of this work involves studies designed to lay the ground work for eliminating bottlenecks in the handling of material in the supply system. It aims to develop data and techniques to improve storage efficiency and facilitate the handling of cargo and other military equipment.

This study, undertaken by the Office of Naval Research,

has included a study and analysis of transportation and shipping problems covering inland transportation, port terminal operations and sea transport. Under a contract with the University of California, engineers and statisticians are studying port terminal operations. We believe that these studies will find new methods to increase the efficiency of port terminal operations.

As the reports of this research have pointed out, "The study of the movement of goods, in the broad sense, must take into account all of the activities which occur between the producer of a commodity and the consumer. These activities are the basis of a complex transportation system. However, the complex system may be treated as a series of distinct components." The study of port terminal operations has been concerned with only one of these components, the movement of commodities between the land carrier and the ship.

In performing this research, the contractor first set out to obtain an accurate idealization, or model, of the cargo-handling system. A systematic analysis of this model, employing modern mathematical techniques and electronic computing equipment when necessary, was then begun. A thorough field study of the time required to load or unload general mixed cargo was made on the docks at a West Coast port. For purposes of analysis, the cargo-handling system was broken down into a series of transporting links. Each link is considered to be the sum of all the movements required of a carrier in transferring a load of cargo from one point to another.

There is the hook link, which is the combination of the hook, cables, booms, winches and operators of this equipment. The wharf link includes the movement of a load between a point on the pier, directly below the hook, and a point in the shed or storage area, which is the next link. The other links are the hold intermediate link, where cargo is dropped temporarily in the hold, and the hold link itself, which is the transportation to or from the point of ultimate stowage in the hold.

The studies made so far indicate that the hook link iss the slowest, but that it is itself delayed almost one-third of the time by the other links. Several correlations between the handling time and the physical dimensions of the cargo, ship and terminal have been obtained. It was found, for example, that a high correlation exists between the time required to stow the cargo and the weight and volume of the individual units.

This information is based upon an engineering analysis

of cargo-handling. The contractor is now preparing a report which will give the results of a <u>mathematical</u> analysis of the data which has been gathered.

Another recent extension of this work has been the making of an extensive survey concerning the use of containers in water, land and air transportation networks. Its objective is to obtain a comprehensive picture of the present state of the art in containerization. Since one of the most important aspects of containerization is the question of the optimum size of the unit load, or module, which is handled, the research effort which will follow this survey will be focused on the development of size of modules flowing in transportation networks.

The cargo-handling research project is a good example of the way research and development strives to keep ahead of operational needs by searching for underlying factors that produce inefficiencies in the supply system. This analytic approach is an effort to seek out and remove <u>causes</u>, not merely treat <u>symptoms</u> one by one as they arise. The better we understand the intangibles we must deal with, the better we can manipulate them to our advantage.

I think I cann illustrate this concept with an example from a military problem in the physical sciences. In Korea, our pilots found that their machine guns were jamming because the lubricant on the ammunition tended to stiffen at the very cold temperatures of high altitudes. Our laboratories immediately set to work to test different types of materials and come up with a lubricant that would not be affected by changes in temperature. This was a pragmatic, engineering approach, designed to come up with a solution in a hurry. At the same time, we embarked on a longer range project, employing the research approach, which was designed to get to the heart of the matter. Its aim was to discover the fundamental principles affecting the movement of molecules in lubricants at various temperatures--what causes them to adhere or move freely around one another. With this knowledge we will have a foundation on which to build not only solutions to the lubricant problem, but to other materials problems as well. Military logistics research today includes this kind of fundamental exploration that seeks to discover and describe working principles which can be used as a basis for the development of techniques and equipment. It does not displace judgment based upon operating experience. Rather, it provides the man with experienced judgment with more objective factors upon which to base his decisions. As in the case of the cargo-handling study, it helps to isolate the areas in which improvements should be made.

The over-all problems are very evident. The advances in military technology have been in the direction of greater speed and complexity. There is a premium on mobility and flexibility. Usage rates of nearly every type of material can be expected to be much higher than in the past. The trend toward complexity has placed much greater numbers of items in the supply system and has greatly increased the number and variety of items which require special packaging and handling, such as electronics components. The supply system must be able to support operations in almost every environment, from hot jungles to dry desert to the Arctic. This places unusual demands on materials handling procedures as well as upon packaging.

In the Navy, some of our most pressing requirements are dictated by the demands of mobile logistic support, about which Admiral Briscoe has already spoken. A principal emphasis here must always be on speed--especially upon improving the rate of transfer from ship to ship and upon speed in striking cargo below decks. During replenishment operations ships are naturally more vulnerable to attack. While striking cargo, the water-tight integrity of the combat ship is broken, because hatches on deck and between water-tight compartments below decks must remain open.

Navy development programs have been working toward improved ship-to-ship rigging and cargo nets for handling the transfer of materials, and new types of conveyors for getting it out of the hold of the issuing ship. New types of overhead cranes and deck equipment, such as wheeled trucks, are under development. The concept of unitized loads, in which individual packages are glued or otherwise fastened together to form large modules is being employed and appears to offer many advantages. We are also experimenting with other devices to speed up transfer. They will be explained in greater detail during some of the sessions to follow.

The Navy is extremely interested in improving shiploading methods, especially cargo-handling gear for combat ships, to speed up the rate of striking the material below, once it has been transferred. The problem is principally a matter of working out techniques for the large aircraft carriers such as FORRESTAL. One fruitful line of attack seems to be conveyors for moving cargo over the deck and into the hold, to gain the advantages of keeping material and equipment moving in a continuous flow, rather than in a series of reciprocating motions.

The Navy is likewise interested in improving methods of materials handling ashore, and has carried out extensive testing

of methods of blocking and bracing in freight cars, more efficient methods of warehousing and other related problems. These will also be discussed in detail later, by men who have been working in this field.

In packaging the many items which must be transported in this system, a major factor is selecting the optimum sizes for the containers. As I mentioned earlier, a part of our logistics research program is now investigating the role of the size of modules flowing in transportation networks. The Bureau of Supplies and Accounts has been conducting studies in such aspects of the problem as the nesting of round containers, to improve efficiency of handling and storing. A main factor from the Navy's standpoint is that no container is useful unless it can be stored on deck or be easily moved through a hatch. Any container which does not meet these fundamental requirements could quickly create a bottleneck in the system.

The greatest problems in packaging have been created by requirements imposed by new developments in warfare. In amphibious operations we are faced with the necessity for hitting the enemy with greater surprise and speed than ever before, to nullify the possible use of atomic weapons against our attacking forces. One answer to this is to develop techniques for bringing troops in by air, which means dropping weapons and supplies by air. The military services are extremely interested in aerial resupply operations in other areas than the beachhead, or course, but I mention amphibious operations because of the Navy's responsibilities in this area. Packaging to withstand the shock of an air drop has created problems for all the services.

One interesting development in this field is the Rotochute, developed to meet Marine Corps needs for supplying beachheads and other confined areas. It consists of two rotor blades attached to a hub, which is fastened to a standard military M2 supply container. The M2 container is currently used for supply drop by parachute. The rotor blade attachment permits drops from lower altitudes and at higher speeds, with greater accuracy than is possible with a parachute. It is much less susceptible to wind drift than a parachute, and will permit pin-point airdrops within small areas.

Another great problem area in packaging has been created by the development of guided missiles, which are now reaching the operating forces in the Army, Navy and Air Force. The central problem here is packaging extremely complex and precise machinery in such a way that it will not be injured by any

shock or vibration in spite of all the handling it must undergo from the manufacturer's plant to the storage areas aboard ship, at an Air Force base or Army installation.

The ticklishness of the problem can be illustrated by a resume of the high degree of reliability that must be obtained if a missile is to function well enough to reach its target. The designer and builder is faced with minimizing every possibility of technical failure in a series of different systems which must all operate together. A typical guided missile contains a fuel system, an engine, a generator, regulated power supplies, antennas, receivers, amplifiers, gyros, computing elements, hydraulic servos and measuring potentiometers--and this is to mention only a few of its parts. Each of these depends upon dozens of sub-components, such as resistors, condensors, transformers and diodes. If we assume that there are only 100 links in this chain, although actually there are many more, the engineer must design and the builder must build so that each one of these parts has less than one chance in a thousand of failure, in order to give us a 90 per cent probability that the missile will complete its mission. When we must demand this degree of reliability from delicate electronic and mechanical systems, we must be absolutely certain that we can package them and move them around without damage.

Since this is a completely new field, no prior experience in missile shipments or storage exists, and conventional packaging methods are generally not suitable for guided missiles. Engineering for the packaging of large, complex items began about ten years ago, with the design of containers for large aircraft engines. The knowledge and experience which was gained in this work is a good foundation for solving the problems of packaging guided missiles.

To design and construct containers for guided missiles entails a knowledge of the environmental conditions to which the package and its contents will be subjected, plus information about the fragility or ruggedness of the missile itself. Many of the difficulties arise from the fact that all of this essential information is not at present available to the design engineer. One step to correct this is the compilation of a book covering all the important aspects of packaging guided missiles, which has been prepared for the Department of Defense under the sponsorship of the Assistant Secretary of Defense for Research and Development. This book is now at the printer. It is an interim publication which was designed to meet urgent needs.

This first comprehensive publication on guided missiles

packaging is truly a team effort, which has been written and compiled with the cooperation of industry. All the military services, the laboratories of other Government agencies and more than twenty industrial concerns are among the contributors to this volume.

It has been pointed out that, ".....there are no fundamental engineering differences between the design of guided missile containers and the design of containers for other types of equipment. The sole difference is the degree of difficulty in arriving at the correct solution. This difference of degree, however, may be of about the same order of magnitude as the difference between designing a model aircraft and designing a guided missile. Over the years, standard rules of thumb have been developed for designing containers for the vast majority of military equipment. For a relatively small number of highly complex devices, reliance on rules of thumb is not sound, and a detailed engineering approach is required. Containers for guided missilee are definitely in this category." This is clearly an area in which a new operational need is placing urgent demands upon our development program.

The age-old problem of packaging materials so they will withstand the ravages of time and the elements has assumed major importance today, when our military forces must be prepared to operate in any part of the world, and when we maintain permanent bases with large supply depots in some of the most varied and rugged climates known to man.

One of the chief problem areas has been the inability to package materials for storage for long periods, such as three to five years. Regardless of conditions inside the package, deterioration sets in from the outside with the passage of time, particularly in tropic environments.

An area in which we feel much work should be done is that of exploring the use of the new materials which are now being developed on almost a monthly basis, with an eye to alleviating potential wartime shortages of more conventional materials, such as aluminum foil. We know that the demand for aluminum and other basic raw materials would rise sharply in case of mobilization, yet at present we depend heavily upon them for packagihg. The present highly vigorous activity in applied chemistry and metallurgy would appear to open many new doors for packaging experts.

Major breakthroughs have been made in developing new methods of staving off corrosion of packaged materials. One of these breakthroughs, the development of volatile rust in-

hibitors, provides a good example of how basic research can lead to unexpected gains in addition to solving the problems which originally prompted the research.

During World War II, the Naval Research Laboratory was performing basic chemical research in an area which held promise for aiding the development of synthetic oils for very high and very low temperature operation. One of the problems was to find rust inhibitors to use with these oils, since they would not contain the inherent rust-inhibiting qualities of natural oils. The basic research on rust inhibition led to the development of inhibitors which were volatile--they vaporized readily and impregnated the surrounding air. Obviously, if we have a substance which will render the air around it "rustproof", so to speak, we have something with great value for packaging. These volatile inhibitors have been developed and they work. Furthermore, the method of using them is extremely simple and provides an enormous advantage to the man who ultimately uses the equipment. One method is to impregnate paper with the rust inhibitor and place a piece of the treated paper in the container.

For field weapons, such as rifles, machine guns and pistols, this provides a very great military advantage, as well as a gain in convenience. Weapons which are to be issued directly in the field need not be packed in cosmolene or other grease. They can be packaged dry, in an air-tight container, with a piece of treated paper in the package and a small tube of the paper inserted in the bore of each weapon. A Marine on the beachhead could receive via air drop a rifle that had been packaged long in advance. When he ripped open the container he would be ready to insert the ammunition and fire.

This technique could be extremely important in affecting the outcome of an engagement fought in very low temperatures, as in Korea, where the thermometer sometimes dropped to 40 degrees below zero. At this temperature a greasy protective coating cannot be cleaned off the weapons well enough to permit them to fire, so resupply directly in the field was virtually impossible. Research has now changed this picture, and the new volatile rust inhibitors should help our ground forces keep ahead of the need for greater speed and greater flexibility imposed by modern warfare.

A few minutes ago I mentioned our studies in cargo handling, and in logistics research in general, as an example of research which uses abstract techniques, such as mathematical analysis, in dealing with fundamental aspects of certain problems. Some of this work is essentially the creation of a laboratory model of a real situation, in order to study it under

controlled circumstances. At the other end of the scale we have research in which laboratory work is obviously not enough, and much of the work on corrosion aspects of packaging is in this category.

The Navy maintains a corrosion laboratory and tropical exposure sites in Panama, where research and development results can be submitted to the impartial judgment of nature herself. This is a facility for combining the hard facts of nature with laboratory precision. Our scientists can put actual materials and equipments out in the jungle, then watch the termites, or the fungi or the humidity rot them away, and make careful measurements of the process. There are facilities for immersing materials in sea water and in fresh water, for leaving them in salt-free air in the interior of subjecting them to other environmental conditions. It is possible to simulate actual operational use, imitating the best possible handling practices and the poorest practices, and see what actually happens to the equipment when it is treated this way in the environments in which it may be used.

This not only helps our research workers to spot a good material; it helps prevent wasting time and money on a poor one. A good example is the work with a material developed to prevent fungal growth on electronic equipment. Preliminary laboratory tests indicated the material would work, but by actual field testing in the jungle our people were able to tell, two years in advance of any concrete laboratory proof, that it was no good. This was one of many experiences which confirm our belief that nature is so complex that we cannot predict just how well a material will last without actually putting it in the field. Field testing new materials under operational conditions is another way of trying to keep a step ahead of operational needs. It enables our research and development programs to put pre-tested materials in the hands of the operating forces, so there is less likelihood of having to go back and retrace our steps.

I have tried to give some indication of the direction and the methods of military research and development in connection with packaging and materials handling. My emphasis has been mostly upon the naval aspects of this field, since this is the one with which I am most familiar. However, it is a field in which many of the problems are common to all the services, and many of our projects are supported jointly by the Army, Navy and Air Force.

The post-war decade has seen a virtual explosion of technology, and the military forces of the world have been

the first to feel its effects. Speed and complexity are the hallmarks of this new era, and flexibility and mobility must be its rewards. More materials must be handled faster; a bottleneck exacts greater penalties than ever before. New materials and new kinds of equipments must be packaged, while costs are kept at a minimum; the rewards for ingenuity are greater than ever before.

It is a challenging picture. We have solved many of the problems that appeared so formidable a few years ago. I am confident that the ones which we are attacking today will yield in time, but by then new discoveries, new weapons and new operating needs will have posed another set of hurdles for us. This is what makes research and development work so interesting.

Recent Industry Packaging Developments

Mr. Charles A. Southwick, Jr.
Technical Editor, Modern Packaging Magazine

Members of the Joint Military-Industry Packaging and Materials Handling Symposium, I just realized, in looking at the program before I came up on the platform, that the speakers following me will talk about four developments of the Military Establishment that have potential interest to industry. The coincidence is that I am going to talk about four industry developments that have potential applications to the military, and I can assure you there is nothing magic in the number "4". It just so happens that, in going over the great many developments that I knew about and were suggested to me, I came up with four that I thought had the greatest interest to this audience at this time.

I think this is a good opportunity to thank the many people that called me and submitted information and told me about many of the developments that I was not too familiar with.

Now, the number of developments that I went through to decide on those I just got today was very large, and I think it is an excellent tribute and an excellent invitation in the amount of research and development work that is going on in industry. It is an excellent tribute to the understanding that American industry has as to the need of research and development.

I had to use some criteria to select these four topics, these four developments today, and, in general, my criteria consisted of knowing whether or not these developments had the broadest possible potential uses in military packaging or preservation.

My other criteria was that they either knew or had expanding interest in new fields. Some of the items that I am going to talk about are not strictly new, but they are moving very rapidly or there has been some sort of a break-through or they are moving into a new field.

The third criteria was that these developments must be commercially available, and I think as I go over these develop-ments you will see why I put that qualification in — either commercial or soon to be commercial.

The first of these developments involves a treatment for making paper greaseproof. As most of you know, paper -- there are only two basic types of paper that are greaseproof as they come out of a paper mill. One is parchment paper and the other is so-called glassine or greaseproof. Now, both of these papers have a high level of greaseproofness. That is, whether you test it by the so-called turpentine method or whether you test them against lubricating oils, they are both an extremely greaseproof type of paper. However, both of these papers have some disadvantages in their limited uses.

Glassine, for example, is quite brittle. Parchment has also wet strength, but it doesn't have the kind of properties that render it genuinely useful for all greaseproof applications and, as a result, there has been a real need for some sort of paper treatment or coating which would render paper, basic paper -- that is, as it comes off the paper machine -- highly greaseproof.

The use of coatings and lamination, such as polyethylene or acetate, in general increase the cost tremendously. They do render the paper greaseproof, that is true, but they do so at a considerable increase in cost.

There have been other attempts to apply different coatings, or even sizings, but those have not been too flexible because of reasons of flexibility.

Now, there has recently been put on the market a process, a sizing actually, for treating paper in the paper machine or adjacent thereto, which gives that paper a high degree of greaseproofness. Practically any basic type of paper can be used, which means that kraft paper would be an excellent base.

The treatment has the further advantage that it doesn't affect the physical properties or appearance of the paper. The treatment can be applied in a considerable range of treatments, anywheres from rendering the paper slightly greaseproof to rendering it so greaseproof that you can't drive oils or fats through it, except perhaps by continued abrasion.

It also appears that this treatment does not in any way affect the greater usefulness of the paper in terms of adhesives or by subsequent coatings by resins or other agents.

There is an unexpected application for the paper of this type in that in many of the laminations -- even laminations involving wax, laminations involving asphalt or perhaps in other applications -- there is a requirement for greaseproof

during processing. For example, the instant the wax laminating agent hits a piece of paper, there is a requirement for greaseproofness that does not continue after the wax-laminated agent has been cooled.

This treatment for base paper has one further advantage. It does impart some degree of wet strength.

Now, the military department, the military organization uses a certain amount of polyethylene-coated paper in which there is some problem, because polyethylene is not the best greaseproofing agent in the world, and the specification requirement is that the greaseproofness be evaluated using turpentine.

The combination of those two elements made the polyethylene paper-coating situation in the greaseproofing area somewhat doubtful. I am very sure that by the use of this sizing agent as a greaseproof treatment forpaper, the matter of polyethylene-coated paper meeting specification requirements will be greatly simplified.

You will now have the situation where the polyethylene will hold back a certain amount of the greasy coating or preservative, or what have you, and the treated paper itself will have . high degree of resistance to grease. I think this will simplify and improve the quality of greaseproof-coated paper in that field.

I think the chief advantage of this treatment is that it will allow you to take a very strong and so-called coarse paper, which is kraft paper, and at very reasonable cost impart a high degree of greaseproofness, and I am sure that this will find many applications in the military packaging field.

The treatment, as I understand it, is available to any paper mill. It will be very carefully controlled by a very well-known company which has done a great deal of research and development, and I offer that to you as the first development that I think has an important future in the field of military packaging, a greaseproof treatment for base papers.

My next development covers both a processand a product. Now, this basic process is not new. It presently is undergoing a very rapid expansion. It is increasing its range of usefulness.

Now, the product and the process of those involves the so-called foamed resins, resinate foam. The present interest is the fact that there is a new resin on the market which

very much simplifies the method of making containers or shaping pieces from it, and the fact that there has been a new series of foamed resins with entirely different physical properties, and those are the polyurethanes, and there has also been some change in the way that they can be used.

Foamed resins are extremely useful to shock and vibration absorbers as insulaters of heat and sound, and its lightweight space-filling means to prevent movement within a package.

In general, all of these resins have excellent dimensional stability, resistance to mold growth. They are water-resistant and can be made with a wide range of both densities. However, there have been some problems in forming them into intricate shapes or of fabricating them into containers.

There is now on the market -- it has just been recently introduced -- an expandable polystyrene that can be used in existing molding equipment with very little change or modification. This resin does require the injection of a certain amount of steam and the application of some heat but, under those conditions, it is very easy to expand into an intricately shaped package of high strength or a pad or a foamed item.

I can very easily visualize the use of this type of resin with very simple semiautomatic equipment foaming very large size pads or shaped objects.

Now, up until quite recently, most of the foamed resins were quite rigid, pretty much characterized by foamed polystyrene with which you are all familiar. However, with the development of the polyurethanes, this range of physical properties has been extended so that some of these resins are almost as soft as sponge rubber.

Now, while I was preparing the notes on this talk, I came across two notices in the trade papers, just within a few days of each other, of a polyurethane-type resin which can be purchased in liquid form and catalyst added, and the resin can be cold-expanded in any size or shape of, well, container, or fill up any space that you wish. It doesn't require any heat or pressure.

Now, I think that has tremendous importance in making some of these resins in the field, because one of the problems in handling foamed resins is the tremendous bulk that you get

with practically no weight, and you have a very high cost if you have to ship them far or do much handling. As a matter of fact, if they had much hydrogen in them, I am sure some of them would have to be held down.

You do now have a polystyrene which is very easy to foam and is available as a resin. You also have a polyurethane in liquid form which can be foamed in place with no heat and no pressure.

Now, the question may be asked as to why we are interested in these foamed resins since there are already lightweight cushioning materials on the market. The answer to that is the fact that there are a great many unsolved problems in the field of shock and vibration. Each new type of resin that can be considered as having usefulness in the field should be carefully evaluated because each one of these materials has entirely different physical characteristics. Styrenes are characterized by great rigidity. The polyurethanes are characterized by having a surface stiffness and a rather increasing softness as you penetrate the surface. The foamed vinyls have a continued yield as you press in; that is, as you press into the resin, it yields continually, much like a coiled spring.

So, you do have in this field of foamed resins and the developments that are taking place a whole new range of physical properties that should be very useful in the field of shock and vibration, and you do have an increasing number of convenient ways of using these resins without extensive shipping.

I, in past years, talked to many industrial organizations and to other military symposia. I didn't expect that I would ever come before one and advocate a package with transparency. I thought I would always be talking about transparency in commercial work, but I am up here this afternoon to try to sell you transparency, not because I am going to glamorize a package or a product, but I think that in certain types of military packaging transparency can be a very useful attribute.

So, much to my own surprise and sense, I am going to talk to you about a package about which one of its chief attributes is transparency. The reason I am interested in transparency in this case is because the particular package that I am going to talk about makes it very easy to identify the product without opening it, and I think that military packaging engineers will generally admit that a great many packages that are fully marked are opened out of sheer curiosity to be sure that the item contained is the one that is wanted, and you and I both

know that when a package has been opened in the field it has a very good chance of suffering deterioration.

Of course, I understand that the Navy solves the problem by giving the package the deep six, but whether it gets it then or whether it deteriorates in the field, a package that has been opened out of curiosity -- usually the part is subject to deterioration. I am talking of the development of vacuum-forming transparent films and the heat-sealing equipment that has now been developed.

You can easily seal them into a hermetic package. Vacuum-forming can be characterized as a simple low-cost method of fabricating many types of thin plastic resins into intricately shaped packages of moderate size. The equipment is easy to operate. The molds are low in cost. By the selection of plastic sheetings of different thicknesses and of physical properties, you can develop a considerable range of size and load capacities.

Now recently, as I said before, this development has been accelerated by simplified positive heat-sealing equipment, which would make it possible to take one of these foam shells and seal the transparent surface over it, which is both oil-proof and otherwise hermetic. The sheetings in question would be cellulose acetate or vinyl chloride. They would be formed into conforming shapes. The product would be inserted. The top sheet would seal into position to make a hermetic package. In the case of small steel parts or ball bearings, a preservative or operating oil can be operated before making the top seal. Later the transparent polyethylene will be available and, with polyethylene sheeting in this same process, you will be able to use a desiccant. Vinyl chloride and cellulose acetate would probably not have sufficiently low moisture transmission to use desiccants, but transparent polyethylene sheeting would allow you to use a desiccant which would further increase the range of usefulness in this packaging forming and closing technique.

The identity of the contents can be given by adhering a label on the outside by printing directly on the plastic or by including a printed plastic label within the package. This would mean that anyone coming along and opening the outer container would be able to pick up the unit and tell at a glance from the contents that they can see, or the label which would be inside and which they could read, and would be absolutely sure of the identity of the part without having any excuse or occasion to open it.

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This packaging structure, this vacuum-formed shell from the top seal, is a very simple type of package to protect against physical damage. It can be shipped in rigid foaming box-type construction with cut outside pads; and, when I think that it is capable of moderate size, I don't think we reached a size limitation as yet. I have seen items as large as 10 pounds if the sheeting is properly selected, and if the item is properly supported that doesn't seem to be the limit.

So, I suggest, gentlemen, that someplace in the military field you consider the use of transparency in the form of transparent sheetings vacuum foam sealed. It is a very necessary attribute for a military package. I am sure that we will see many more transparent packages as a result of this development.

Development No. 4 is one of great interest and great potential. It is certainly greater than those three that I have talked about before. Unfortunately, this development has been badly misunderstood because of too many claims and a great dearth of facts, and I am talking about the so-called low pressure polyethylene. I don't think there has been a substitute in the last few months that there has been so much talk about but as little known about as the so-called low pressure polyethylenes. I am going to attempt to tell you something about them, give you some idea of their packaging capabilities, but I am certainly not in a position to answer all the questions that I would like to be able to answer.

Now actually, we are not interested in whether the polyethylene is made by high pressure or by low pressure -- or its composition, for that matter. We are interested in what it does, what it can do and its cost.

Because I was going to include this development, I had to include the statement in my criteria that, in the developments which were commercial or would be soon commercial, actually there is very little of this so-called low pressure resin around, and there is very little known about it. I have drawn together a table which I think briefly summarizes the important packaging characteristics of typical high pressure, which is your available resin, and the new low pressure, which is the resin that I am talking about. I want it understood, however, that these properties are subject to considerable variation and that I am assuming a rather average type of resin. Both the high pressure and low pressure polyethylenes are capable of considerable variation, as you know.

I am assuming a rather typical resin and I am going to attempt to give you the general properties of both as a matter of comparison.

I believe this table would be a lot easier to understand if you had copies in front of you, and it will be presented in the transcript of the table, but I will try to read it off. The title of the table is "A Comparison of the Major Packaging Characteristics of High Pressure Versus Low Pressure Polyethylenes."

The first item is "Transparency." Outside of that, I have this statement: "Both types of resins are capable of complete transparency." Right now, the present type of polyethylene is somewhat cloudy, but it is getting clearer and I have been assured by the makers of the low pressure type resin that they will also make a clear or transparent polyethylene. Both resins are capable of transparency. Both types of resins will be printed if they are pretreated.

I presume that all of you know that printing any polyethylene without having it go through some type of pretreatment is a very difficult operation. Pretreatments are simple and very effective, so that either one of these resins will be printable if pretreated.

The next item I have is "Water Vapor Transmission." High pressure resins have a susceptibility to water vapor of 1.1 grams per hundred square inches by the so-called General Foods method. That is per mil of film, per mil of thickness. The low pressure resin has 3/10ths of a gram.

Now, that's a very significant difference, a difference of three to one, and a very important problem. In other words, the new polyethylene, the low pressure polyethylene, can be expected to produce films or containers, bottles -- anything you wish -- that are at least three times more moisture proof than the present grade of resin.

Now, that may be subject to some modification, but that, I think, is a general magnitude of the difference.

The next item is "Gas Transmission." The present type of resins are characterized, in the field of gas transmission, by having a relatively high transmission, a relatively large number of cc's per unit area.

Now, as you begin to suspect probably from the water vapor transmission values, the new low pressure resin has quite low gas transmission values. It will, of course, depend upon the test conditions, the gas, and perhaps the particular number of the resin involved, but you can expect them to be low. In other words, water vapor and gas transmission of the new resin will be considerably lower than for the present resin.

Here is another important characteristic, "Resistance to Mineral Oils." As I said earlier, present types of polyethylene, whether coated on paper or as a film, are not ideal means of grease-proofing against mineral oils and man y of the preservative compounds. I characterize that in the present resin by saying "swelling and penetration," but with the low pressure resin I say "superior but swells."

Now, that means that you are not going to solve completely all greaseproof problems with this new resin. It is better in that it will have a higher resistance to penetration by the petroleum oils. It will swell probably less. It will take a longer time to swell, but it is not enough greaseproof to be characterized as a greaseproof material. Maybe it is enough better as a paper coating so that it will allow the use of less resin. It may do a better job in some cases, but it is not a completely greaseproof resin.

The next important property that I have listed is "Low Temperature Durability." In this case, both resins are excellent. I am sure that some of the low pressure resins will show some embrittlement, but I am also sure that they can be modified so that they do rate the qualification of "Excellent," so both types of polyethylene resins are excellent in low temperature durability.

The next important property is "Tensil Strength." The present resins show a tensil strength of from two to three thousand pounds per square inch. The low pressure resin will run from four to five thousand pounds per square inch, practically double.

Another important characteristic of this resin, or any other resin, is "Stiffness," and, as you all know, present types of polyethylene are fairly soft. The new resin I have characterized as having good stiffness. There again that will depend, to a considerable degree, upon the resins selected, but the important thing to remember is that this resin is capable of making a stiff film or a stiff container.

Actually, film made from this resin is as stiff as cellophane and sounds much like cellophane.

Another important characteristic is "Impact Strength", and in this case both strengths are rated the same, both excellent in impact.

The next packaging characteristic that I have here is the "Heat Sealing Range." As nearly as I can find out, the new type polyethylene has about a 50° Fahrenheit higher working range than present resin, and that means that where the present resin will seal, heat seal from 230°F. to 300, the low pressure resin will probably seal from 280 to 350.

Now, the 350 figure is getting up to where you are getting change of paper if your times are long or there is rapid disintegration of any organic matter, but it may be necessary to feel certain grades of this new resin.

The last item I have on this table is "Minimum Use Temperature." That should be "Maximum Use Temperature." Actually it is; I'm sorry — "Maximum Use Temperature" — and there again it is about 50° higher than the present resin.

Now, actual maximum use temperature will depend upon a great many factors and conditions. There are many ways of measuring it. They all involve the use of temperature, and some involve the use of humidity and certain degrees of pressure, but it looks as though the present resins would be effective up to about 180° F., and the low pressure resins could be expected to push this range up to 220° F., a substantial increase in the working temperature range of the resin.

Now, to summarize, it is quite apparent from this comparison that there is a very substantial difference in many of the properties of these two types of resins. The high pressure type resin is a softer resin with higher values for gas and water vapor and is more severely affected by mineral oils. The low pressure resin is much stronger and stiffer, has much lower values for gas and water vapor transmission; and, while its resistance to mineral oils is somewhat better, it is not enough to warrant a designation of oilproof.

Incidentally, while we are talking about high pressure versus low pressure, you might be interested in why the names "high pressure" and "low pressure" were attached to these resins. Present polyethylene is manufactured at pressures in the neighborhood of 30,000 pounds per square inch at somewhat elevated temperatures, and that, I think, is a pretty good case for calling it "high pressure" resin.

The low pressure resin appears to be manufactured at pressures below 1,000 tons per square inch, and the pressures may be below several hundred pounds per square inch; so that, while it isn't important for packaging uses, you can very easily see why it makes a very simple handle to differentiate these two resins, one being made of 30,000 pounds per square inch and the other being made of less than 1,000; so that is the reason for the "low pressure" versus "high pressure" designation.

In my opinion, the clue to the differences in the properties and the performances of these two resins lies in the fact that the low pressure resin is more nearly a straight chain hydrocarbon and has about 95 percent crystalline, while the high pressure resin has a considerable and assorted branching of about 60 percent crystalline.

These differences in the molecular configuration and in crystallinity are the result of the basic differences in the two processes of manufacture.

The conclusion that I wish to draw from these data is that we now have, or we will shortly have, two widely different types of polyethylene resin. Each type is capable of subdivision into many grades, each having a considerable range of property for different end uses and for different types of converting equipment.

Another very important fact is that each one of these types of resins is soluble in the other, so we have, in effect, a blending which can create a third series of new resins. Unfortunately, it is going to take some time before there is sufficient available low pressure resin in all the various grades so that we can thoroughly evaluate it, but I would like to predict that this resin will make a very important contribution in the field of plastics technology and in the plastics field.

Now, in the foregoing, I have briefly gone over four arbitrarily chosen developments. As I said earlier, there are many more that happen to have greater interest to some of you, and certainly of interest in the military field. In going over the program, I have noted that some of them will appear in the program and will be brought out at later meetings.

In my opinion, symposia of this type are very effective in acquainting industry and the military services with each

other's progress, and I hope that they continue. I am sure that industry would be happy to cooperate with the Department of Defense by having its technical people meet regularly with the technical people of the military services to exchange ideas and attack problems of mutual interest. I know that such meetings will stimulate and accelerate progress in all fields, including packing, packaging, and preservation. These meetings of small groups of civilians who are working on similar problems in both industry and the Military Establishment can result in great savings of time and money in the Department of Defense.

Monday PM Oct. 10, 1955

"Thin Films of Teflon as Operating Lubricants and Preservative Coatings"

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During the first winter of the Korean War considerable difficulty was encountered in the operation of the 20mm cannon used in Naval aircraft. The Bureau of Ordnance requested the Naval Research Laboratory to investigate the problems of cold weather operation and lubrication of guns and ammunition over the temperature range -70°F to 160°F. A task group of chemists, physicists and engineers made a rapid analysis of the lubrication requirements of the entire aircraft gun system and then, through a chemical development program, produced supplies of synthetic oils and greases to meet those requirements. The new materials proved satisfactory and were adopted by the Navy.

However, it was recognized that a completely satisfactory solution to this problem had not been obtained since the use of oils, greases or waxes as cartridge lubricants caused some difficulties through pickup of airborne contaminants and by adulteration of the gun lubricants. Also, when the cartridges were lubricated by any of these methods, no satisfactory storage practices could be developed. Therefore, large numbers of personnel had to be assigned to the duty of laboriously hand-lubricating cartridges to be installed in planes just prior to combat flights.

Dry Film Lubricants for Ammunition

In the Winter of 1951, NRL initiated for the Bureau of Ordnance, an investigation of the possibility of using thin coatings of solids as dry film lubricants for cartridge cases. Following conferences with Navy and Army ordnance experts the requirements for an ideal solid lubricant coating for cartridges were established. These are:

a. A coefficient of friction of 0.1 or less over a temperature range of -70° to 500°F.

b. Good adhesion to both steel and brass over the prescribed temperature range.

c. No melting or pronounced softening up to 500°F.

d. Ability to protect brass and steel from atmospheric corrosion.

e. Lowest possible adhesion for water or other contaminants.

f. Resistance to abrasion, cracking or embrittlement over the required temperature range.

g. Low thermal conductivity.

h. Low solubility in oils or cleaning solvents.

i. Freedom from chemical degradation.

j. Ease of application without effect on the metallurgical or mechanical properties of the cartridge.

k. Economical justifiability and adequate availability.

l. Ability to provide adequate lubrication for cartridges.

Fourteen materials, which for one reason or another appeared promising as possible dry film lubricants, were carefully examined at NRL. Most of them were discarded rapidly in early laboratory tests. Of these, some exhibited coefficients of static friction which were too high, others were too readily wet by oils, common gun solvents, or water, and few were either too soft or too low in melting point.

It soon became apparent that the most promising materials were resins containing graphite or molybdenum disulphide and the comparatively new highly fluorinated polymers such as Teflon, Kel-F, or copolymers. The latter could all be described as plastics having extremely low surface energies. Fundamental research on the wettability properties of fluorine and/or chlorine containing materials (references (1) - (6)) had been in progress for years at NRL, and the large amount of information available made it possible to demonstrate quickly that polytetrafluoroethylene ("Teflon") was the most promising plastic for application as a cartridge lubricant. In fact, Teflon conformed to all of the aforementioned requirements except one; the available Teflon coating material at that time did not adhere to metals as well as was desired.

The early cooperation of E. I du Pont de Nemours and Company was invited in order to obtain the most suitable aqueous dispersions of Teflon for either dip coating or spray coating 20mm cartridges with Teflon. This cooperative development program led to much more satisfactory Teflon dispersions, more effective techniques of application, and more adherent Teflon coatings for ammunition.

A brief summary of the resulting method of coating ammunition with Teflon may be helpful at this time. After the aqueous dispersion of Teflon particles in water had been applied to the metal and the cartridge had been dried in the air, it was then fused into a continuous film at 725°F. Techniques of metal surface preparation were evolved which produced greatly increased adhesion between metal and Teflon. Experimentation demonstrated that there was no method for applying the Teflon preparations without using a minimum fusing temperature of 725°F. Several heating methods for fusing the Teflon particles were investigated since some metals were physically affected by the 725°F fusing temperature, notably brass and aluminum. It was found that radio frequency heating of the Teflon coated cartridge followed by a water quench was effective without any significant loss in tensile strength resulting from the fusing operation.

After the techniques for applying Teflon coatings to cartridges had been worked out, a new investigation was undertaken of the properties of such films as opposed to the properties of bulk forms of the plastic (references (7), (8), and (9)). It was found that while Teflon is a soft plastic in bulk and will cold flow at 2000 psi, where used in thin films on hard surfaces, loads of over 50,000 psi can be carried without extruding the film. Cycling under a load of 50,000 psi produced coefficients of friction of only .04.

All other solid films investigated produced coefficients of friction at least 2½ times greater. For instance, Kel-F, a plastic similar to Teflon but containing one chlorine atom in each monomer, was found to have coefficient of friction of 0.43. Such a large coefficient of friction produces galling, welding and tearing. This nearly tenfold rise in friction in going from Teflon to Kel-F is an example of a general rule discovered during the related early investigations that chlorination greatly increases wettability, adhesion and dry friction in all polymers. In contrast, fluorination always reduced friction, wettability and adhesion; thus Teflon a fully fluorinated compound has a uniquely low coefficient of friction.

It was determined that the low coefficient of friction of Teflon in contact with a dissimilar material was the same as that for Teflon on Teflon. This was found to be due to a transfer of a thin film from the Teflon to the other surface being rubbed. Because Teflon has low adhesion for itself, it cannot be friction-welded to itself; therefore, there is no build-up due to the transfer property of Teflon.

Teflon has low adhesion for practically all solids and

liquids. This property was found advantageous where Teflon was used as a dry film lubricant, since Teflon coated surfaces were found to be repellent to contaminants. However, when solid contaminants are trapped on Teflon lubricated surfaces, the transfer property of Teflon is a disadvantage. Minute amounts of Teflon adhere to the particles of the contaminant and cause a loss of the lubricating film proportional to the surface area of the contaminating solid coming into contact with the Teflon film. Also, where Teflon is used as a lubricant against surfaces which are dissimilar continuously there will be an erosion of the film due to continuous transfer.

Since it was a prime requisite, the frictional properties were investigated first. However, the need for corrosion preventive properties in such films was apparent, especially if they were to be used to coat the new steel cartridges. Numerous test specimens were coated with a variety of Teflon suspensoid formulations and the rust preventive properties were observed in accelerated fog cabinet corrosion tests. It was found that films having satisfactory resistance to both rain and salt water spray must consist of at least two coats of Teflon totaling 0.5 mils to 0.7 mils in thickness. This work indicated that 150 hours of resistance to 20 percent salt spray at 120°F could be obtained on steel provided the inherent porosity of single Teflon films was overcome by using at least one additional coating of Teflon. Teflon is so inert there is no change in its protective properties with time or environment. Porosity is the main problem in obtaining protection against corrosion.

Various laboratory evaluations were made of other properties of thin films of Teflon on metal. Short term exposures to 1000°F did not damage the film. Low temperature tests to -75°F indicated excellent adhesion under impact, thermal shock and abrasion. It was also determined that no common lubricant or any commonly used solvent had any softening or solubilizing effect on the Teflon film.

The same evaluations were performed on two commercially available dry film lubricating coatings which have considerable industrial usage. These two candidate materials had coefficients of .09 to 0.1. One consisted of molybdenum disulfide dispersed in a synthetic resin and the other, graphite, in a similar resin. The resin bonded dry film lubricants did not meet many of the requirements outlined previously. Nevertheless, it was decided to conduct tests on these two because of the materials examined they were the next best to Teflon coatings from the standpoint of lubrication.

In the final comparative tests of the dry film lubricants, severe gun firing tests were performed at NRL and at the Naval Proving Ground, Dahlgren, Virginia, with the result that only the Teflon coated cartridges were satisfactory in all respects. A long series of tests, reported in reference (10), established the suitability and uniqueness of Teflon as a dry film cartridge lubricant. As a result, the Navy Bureau of Ordnance and the Office of the Chief of Ordnance of the Army initiated further military and industrial activity on the use of Teflon films as cartridge lubricants. Both Services contracted for industrial pilot scale production of 20mm cartridges coated with Teflon. Extensive firing and test programs have been in progress for some time by both Services to determine the methods of application most suited to provide satisfactory coatings both from the mass production and performance standpoints.

Dry Film Lubricants for Small Arms

Several years ago, an investigation was begun at NRL on the practicability of lubricating and protecting the mechanisms of small arms with Teflon. For example, thin coatings of Teflon on rifles and pistols appeared promising provided that sufficient durability in everyday use could be established. Preliminary firing tests at NRL quickly established that films of Teflon only 0.5 mils thick provided excellent lubrication to the reciprocating mechanisms so widely used in small arms.

The resulting increased interest in Teflon coatings for ordnance equipment necessitated a local shop facility for coating the varied objects selected for testing or experimentation. Consequently, a Teflon coating facility at the Naval Gun Factory was established by the Bureau of Ordnance with the technical assistance of NRL.

Interest of the Marine Corps Development Center, Quantico, Virginia, was aroused in the performance of infantry weapons coated with Teflon. A cooperative project involving the Bureau of Ordnance (Code Rel) and NRL was established at the Marine Corps Development Center to test the performance of approximately twenty small arms, rifles, carbines and machine guns, each of which was coated at the Naval Gun Factory with a two-coat system of Teflon. In planning the test program, it was recognized that if such coatings could withstand the tests outlined by the Marines, it would become feasible to coat the weapons at the time of manufacture for not only combat use but also for purposes of storage and preservation. Such coated weapons would be in a complete state of readiness for instant use anywhere in the world. Therefore, the Marines subjected

the Teflon coated weapons or weapons' components to comparative tests with counterparts lubricated or protected with conventional materials in the conventional manner. For instance, Teflon coated components were compared with those coated with "Cosmoline" in salt spray chambers, tropical chambers, "Weatherometers," low temperature chambers and in normal troop storage and use. In all of these tests the Cosmoline coating gave comparatively poor protection. In the low temperature tests, the Cosmoline coated weapons became completely inoperable. Where corrosive atmospheres were involved, the Cosmoline coated parts could not be operated at all because of extensive corrosion, and in most cases the parts could not even be salvaged. The Teflon coated test components were always operable even in cases where slight corrosion occurred. It is worthy of note that at temperatures of -80°F there was no tendency of the Teflon coated weapon to stick to bare skin as was the case with conventional weapons. Such a property is an advantage where adjustment or repair of the mechanism must be accomplished at subzero temperatures.

Firing tests of the coated weapons were made under the most adverse conditions; sand was introduced into the mechanisms; firing was done so rapidly and for so long that the wood surfaces contacting the barrels ignited; no gun cleaning was permitted for 8 months except for the interiors of the barrels; some of the weapons were submerged for days in a chlorinated swimming pool and were never dried or cleaned afterward. At the end of the test period of 8 months, only the Teflon coated weapons were still functional - not one had failed.

During this time several machine guns were fired for 15,000 rounds each, several rifles were fired over 10,000 rounds each, and the carbines were fired over 4,000 rounds each. Not a single malfunction occurred due to faulty lubrication. All comparative firing tests with conventional lubricants produced malfunctions.

The recent report of the Marine Corps Development Center on the performance of Teflon coated weapons (reference (11)) concluded that:

a. "Teflon is a suitable preservative for long term storage of weapons under those conditions which might exist at a storage site."

b. "Teflon is superior to Cosmoline in corrosion prevention properties and in the ease with which a weapon may be readied for action."

c. "The original coating of Teflon provides satisfactory lubrication for weapons under all circumstances for an almost indefinite period following issue."

d. "Teflon provides good protection for weapons in the hands of troops until approximately 1,500 rounds have been fired. The coating then wears to the point where the preservative properties disappear from high friction localities. This wear entails no loss in lubricating property."

e. "Conventional preservative procedures may be used without detriment to the lubricating properties of Teflon."

f. "Weapons once issued and used should be recoated before being returned to storage."

The recommendations of this report are:

a. "Teflon be considered suitable as a preservative for long term storage of weapons."

b. "Teflon be considered suitable as a lubricant for small arms in troop use."

c. "The use of Teflon as a lubricant for the moving parts of all Marine Corps weapons be investigated."

Application to Ships

While the foregoing program was in progress, NRL interested the Bureau of Ships in the use of Teflon coatings for applications on submarine and ships. This led to cooperative activity between the Bureau of Ships and NRL in the establishment of Teflon coating facilities at the Portsmouth Naval Shipyard and the Mare Island Naval Shipyard. This work has permitted an extension of the equipment preparation and evaluation programs.

Large numbers of inboard and outboard mechanisms have already been coated on 17 vessels. All of these applications of thin films of Teflon were primarily for purposes of lubrication alone and not as corrosion preventives. Satisfactory lubrication performance for over one year has already been reported. Not only have the Teflon films been more successful than conventional lubricants, but a weight saving in greasing equipment of up to four tons per submarine is now believed possible (reference (12)).

It is to be emphasized that all successful applications

of Teflon films under conditions of exposure to sea water have been with corrosion-resistant metals. Film porosity problems make Teflon films on steel or iron too vulnerable to corrosive attack under conditions of prolonged exposure to sea water.

Application to Torpedoes

During the past year an entire torpedo, MK 23, was Teflon coated through the cooperation of the Naval Gun Factory, the Alexandria Torpedo Station and NRL. It was test fired by the Keyport Torpedo Station numerous times. It was observed that corrosion was minimized by the presence of the non-wetting coating. The report the Keyport Torpodo Station recommends further testing of Teflon coated torpedoes and urges the investigation of such coatings wherever applicable to spare parts to improve the shelf life.

Miscellaneous Applications

A recent problem, which has been solved at NRL by the use of Teflon coatings concerned an actuator mechanism containing a gear train and screw jack assembly. Here the problem was storage incompatibility between low temperature synthetic lubricants and low temperature elastomers. Through the use of dry films of Teflon as a mechanism lubricant and preservative coating, conventional lubricants which always produce solvent effects on elastomers, were eliminated. Satisfactory performance of this actuator is now possible over a wide temperature range.

Another storage problem which Teflon coatings appears to have solved concerns a new release mechanism for parachutes. The preservative lubricants used on these mechanisms deteriorated and thickened during long storage. Eventually this caused the mechanism to become inoperable. Coating such mechanisms with Teflon provided both all-weather lubrication and a durable, effective, and reliable protective coating.

Recent Work at NRL

A more recent NRL investigation, which is now approaching the evaluation stage, concerns the development of Teflon coated steel wire rope. Steel wire cables have been limited in flexibility and durability by the fretting wear between the wire filaments and by atmospheric corrosion. Preliminary experiments at NRL on coated steel aircraft control cables were so impressive that a development and test program was originated in cooperation with three companies: Fabrics and Finishes

Department of E. I. du Pont de Nemours and Company, American Steel and Wire Division of U. S. Steel Corporation, and Hitemp Wires, Inc.

Satisfactory coatings have now been produced on single filaments of steel which have high abrasion resistance and remarkable resistance to atmospheric corrosion. It is believed that these coatings can be applied by high-speed continuous production methods. The next phase of this program will involve fabricating the wire rope from the coated filaments using standard production equipment. Finally, the coated rope will be tested by the Navy and industry for resistance to flexing, abrasion, corrosion and fretting under tensile loads.

Conclusion

Despite the many successful applications of Teflon coatings described here, such coatings are not the answer to every problem involving lubricants nor are they always the best method of preserving metal equipment. There are more weather-resistant coatings than Teflon. However, coatings of Teflon are unique in having both good lubricating and good preservative properties.

The corrosion preventive properties of Teflon depend on the complete integrity of the film; therefore, porosity due to improper application or mechanical damage will permit water to penetrate the film and, therefore, will permit corrosion. When corrosion of Teflon coated metal occurs, the damage is unlike that which occurs on painted surfaces; there is no lifting of the coating and no spreading of the corrosion under the film. Where Teflon is used as a lubricant and the coating is penetrated by sharp objects or abrasives, corrosion can occur. Teflon coatings are not competitive with some of the excellent protective coatings now in existence either from the standpoint of protectiveness or of economy. The use of Teflon films should be based on their unique combination of properties, and for our purpose here the dominant interest is in their value as lubricants; the protective attributes should be considered as an additional benefit.

Numerous items such as slides, gears, bushings and journals have been coated with Teflon films for lubrication tests in a variety of mechanisms. Nearly all have been highly successful applications. The selection of the particular mechanisms to be lubricated with Teflon films has been made on the basis of one of the following three considerations:

a. The item to be lubricated by a dry film of Teflon is subject to low surface speeds and light to moderate loads.

b. The item to be lubricated with Teflon has a coolant present such as water, oil or an air blast.

c. The item to be lubricated with Teflon is expendable or has a short term use before overhaul.

Such rules of selection are necessitated because even though there is such a low coefficient of friction as 0.04, if the amount of power expended is high, there will be a considerable generation of heat at the Teflon bearing surface. Due to the fact that Teflon has low thermal conductivity, the rate of heat dissipation from the loaded areas will be too low and in the resultant rapid rise in surface temperature, the polymer coating will soften and shear off.

Many of the difficulties reported to us from attempts to use Teflon films as lubricants have been through misconstruing the nature of this material or misunderstanding the uses which we advocate for it. It is not a panacea for all lubrication problems, nor is it always the best protection for metals just because it is the most chemically inert plastic.

A variety of military and industrial uses for which Teflon coatings may be of advantage in lubrication or preservation have been outlined. This NRL program of research and development has been conducted with the view to establishing firmly the principles for applying thin Teflon films on hard backings to problems of boundary lubrication. A great deal of cooperative equipment testing has resulted since only service tests are completely convincing. "Since nothing succeeds like success" it is hoped that the successful applications described today will enable others to employ thin coatings of Teflon with confidence and, we hope, with discrimination.

In conclusion, we are grateful for the cooperation extended us in this program by the representatives of the many Navy Bureaus and establishments already mentioned. Our thanks as well as those of the Naval Research Laboratory are due to the DuPont Company and especially to Mr. Harry R. Young of the Fabrics and Finishes Department and to the late Dr. Wm. S. Calcott of the Organic Chemicals Department. This program has been an exciting experience for us because several apparently remotely related and rather academic studies of the chemical and physical properties of a new material have led us from the comparative quiet of the laboratory to such direct and exciting military applications as to ammunition, guns, torpedoes and ships.

V. G. FitzSimmons   Monday PM   Oct. 10, 1955

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Monday PM Oct. 10, 1955

Techniques for Delivering Material and Equipment to Inaccessible Areas

Captain Cecil W. Hospelhorn, USA
Quartermaster Research & Development Command

Gentlemen, the methods by which we have transported material and equipment to our combat troops in past wars will not fulfill our requirements in future wars. Aircraft are fast replacing the old 2½-ton truck. The logistical life line must keep pace with the new concept of warfare where mobility is stressed as the key to victory, flexibility a definite must, and striking power a necessity.

There are but two methods wherein aircraft can be used to deliver material and equipment to the using units. The first is to land on the surface of the ground on prepared airstrips or suitable unprepared fields and off-load (commonly called airlanded supply). The second is by means of aerial supply, or, to put it in other terms, an aircraft that off-loads supplied while in flight. This involves the use of various techniques in insuring safe descent and ultimate receipt of undamaged items when contact with the ground has been made. It is of this particular phase of supply support, that of aerial supply, that I wish to discuss with you today.

Aerial supply is big business and as such must compete favorably with the cost of the commonly known means of transport that we have become accustomed to in past wars. The method of supply, however, entails new techniques in preparation of material and equipment for delivery, new types of equipment, called Quartermaster air type items, with which to do the job, changes in ground handling techniques, radically new concepts in receipt and stockpiling supplies in the combat zone, use of parachutes and Quartermaster parachute riggers, and many other phases on which I will not dwell at this time. There is one of utmost importance, however, to you, and this is the fact that the internal packaging techniques as applied to many items required by the military in any future war may well have to undergo radical changes. This we will discuss in greater detail in a few moments.

Aerial supply can be broken down into two major activities. The first is what is commonly called equipment drop. Equipment drop consists of dropping vehicles, guns and other items of combat equipment by parachute. The second is the

dropping of material consisting of supplies (ammunition, rations, water, gasoline, clothing) and other necessary items to be utilized by combat units.

Even though similar techniques are utilized in each of these activities, I make the distinction in order that I might discuss the aerial supply of material with you as the main topic of discussion.

HISTORY.

World War II brought about the first significant use of aerial supply. This use, however, was primarily emergency in nature and was never utilized as the sole method of supplying combat units over any extended period of time. The bulk of this type of activity was in support of our fast moving, hard hitting parachute units. Here we see the mobile capabilities of units for the first time, causing those units to become inaccessible to normal ground channels of logistical support. As we know, different areas of combat can become inaccessible to normal means of supply support for many different reasons. It may be because the enemy has encircled our forces, that terrain features preclude the use of vehicular equipment, that weather conditions hamper ground movement of supplies, or even the fact that the tactical commander has over-extended his supply line. In any event, supply support must be available at all times under all conditions.

World War II aerial supply was limited to items of relatively limited sizes and weights. The usual weight of an aerial supply container packaged for drop was 300 lbs. Items of equipment were disassembled for drop and of course had to be reassembled by the receiving unit before use.

During this period of time, techniques utilized in aerial supply were tailored to meet the capabilities of available aircraft. At the close of the war, the first aircraft (the C-82, first of the flying boxcars) was designed to meet the needs of air drop requirements, and later on its big brother, the C-119 flying boxcar in 1948-1949, was designed to further fulfill this role.

The Korean war brought about perhaps our first faint preview of wars to come as related to the air drop of material and equipment. History will record that for the first time in warfare an airborne unit (the 187th Airborne Regimental Combat Team) was dropped by parachute complete

with 1/4-ton trucks, 3/4-ton trucks, 105 MM howitzers, 90 MM antitank guns, weights ranging from 3500 lbs. to 9000 lbs. This particular conflict brought out several firsts, another being a bridge (M-2 treadway) dropped by parachute to the 1st U. S. Marine Division and elements of the U. S. Army 7th Infantry Division in the Chosen Reservoir area. Incidentally, a Quartermaster Aerial Supply Company performed these missions in conjunction with the U.S.A.F. Troop Carrier Forces. A total of approximately 18,000 tons of ammunition, rations, gasoline, water and other supplies were dropped to all ground forces by parachute and free drop during the one year period of 1950-1951.

The Department of the Army has charged the Quartermaster Corps with the mission of parachute packing, maintenance of Quartermaster air type items of equipment and aerial supply. As a part of the over-all mission, the Quartermaster Corps has research and development responsibility in support of these three areas of endeavor. The Quartermaster research and development program in support of air type items is funded by the Department of Defense through the Department of the Army. In addition to the use of Quartermaster personnel and facilities, the Quartermaster Corps utilizes facilities and personnel of sister services. This is deemed necessary to preclude duplication of effort and to provide maximum utilization of those facilities presently in existence.

TECHNIQUES OF AERIAL SUPPLY.

What is involved in the dropping of supplies? You will recall I mentioned earlier the problem of internal packaging of military supplies. It is the intent of our Army, wherever practicable, to drop all required material as it presently is packaged in the overseas pack. If the item in the overseas pack cannot be dropped successfully without additional outside cushioning or use of energy absorbing materials, then this is added to insure safe delivery. Drops are normally made from 1000-feet actual altitude. However, it is hoped that procedures can be worked out in the near future to enable the dropping from any height and still hit the drop zone of the area requiring the items.

There are three types of drop;

A. Parachutes.

B. Directional control or stabilized drop.

C. Free Drop.

A. Parachutes.

The parachute still performs the major portion of the job in lowering supplies to the ground from an aircraft in flight. Parachutes presently used range from a 300-lb. capacity up to and including 3500-lb. These can be used singly or in clusters of two or more, dependent upon the weight of the particular item to be dropped. The largest single piece of equipment that can be dropped successfully by parachute weighs approximately 22,000 lbs.

Parachutes are expensive items. The search for less costly, and in fact an expendable, parachute is a continuing one. The parachute must perform its mission, however, and its cost, size, design and functional characteristics are dependent upon other developments that we will discuss at greater length in just a moment.

B. Directional Control or Stabilized Drop.

Directional control or stabilized drop may or may not involve the use of a parachute. The term in itself implies the use of some means for orienting the item being dropped so that ground contact or impact will occur on a predetermined surface of the item. The orienting of the item being dropped will permit more effective use of internal and external packaging materials. Let's take, first of all, the external packaging materials or energy absorbing materials and determine the effect of this particular type of drop. Without orientation of the item being dropped we would have to package the item or enclose it on all surfaces, realizing, of course, that in this case, you could not predetermine the side that would make ground contact. Orienting in this case would allow us to concentrate our packaging efforts to one surface, thereby reducing the over-all requirement for packaging materials. The internal packaging poses a much different problem and it is not known at this time the actual impact that this type of drop is going to have on our internal packaging methods as now used for the various and sundry items.

C. Free Drop.

The third type of drop is one in which the item is allowed to fall from the aircraft to the ground without the aid of any retarding device. This type of drop, however, may

include some features of directional control. Free drop is thought by many to be the ultimate in goal to reach in air drop activities. However, dependent upon the material and/ or equipment, as well as the capabilities and characteristics of energy absorbing material available, we will in all probability utilize any or all types or combinations thereof to be successful in this mission.

PACKAGING FOR AERIAL SUPPLY.

The term packaging as used in aerial supply activities consists of two types. The first is the item as packaged for overseas shipment. This may be accomplished at the manufacturing plant or in an Army depot. This is referred to as internal packaging. The second is the packaging or use of cushioning or energy absorbing materials on the outside of the overseas packed item to further protect it from damage on ground impact. The packaging problem, both external and internal, is the key to success in the aerial supply field.

This statement is borne out by the findings of the Korean War aerial supply activities. Knowledge of cushioning or energy absorbing materials during this period of time was very limited. Trial and error was the means by which techniques were developed to fulfill the aerial supply mission. The only energy absorbing materials used for the most part were the internal packaging materials as already existed inside the case of rations, ammunition and other items. It was found that in most instances this was not adequate. The lack of energy absorbing materials necessitated other action. To slow the rate of descent for the parachutes used, the total capacity was reduced by one-sixth the total rated capacity. This was an arbitrary rule of thumb and it produced results. Percentages of damage were reduced, but the cost was high. It is estimated that during the year 1950-1951 in Korea some 3600 tons of additional supplies could have been dropped utilizing the same parachutes (144,000 total) if proper energy absorbing materials had been available. Ground impact could not be compensated for by means other than slowing the rate of descent. This is no longer the case. Testing and development of new energy absorbing materials is now a major portion of present research and development activities.

The primary cushioning or energy absorbing materials used have been felt padding and cellulose wadding. Paperboard honeycomb material has now been developed and is

considered to be a strong contender for the first major development in this direction. High impact of the item being dropped over a very small span of time makes it necessary to have an energy absorber that possesses little or no resiliency. The significance of this search for effective energy absorbing material is this: "The more efficient the energy absorbing material (everything else being equal), rates of descent can be increased, parachutes made smaller and cheaper in cost (perhaps eliminated in some instances), accuracy in hitting drop zones is enhanced in that wind drift will have little effect on the fast falling item, preparation of supplies for air drop would involve less time." Support activities such as the parachute packing workload could be reduced. These are but a few of the advantages believed to be obtainable. The development of energy absorbing materials has already developed trends of thought that aerial supply activities will be revolutionized. Instead of spending huge sums of money to slow the descent of the supplies, we hope to spend less money and cushion accelerated rates of descent by use of these materials.

There are certain factors that must be determined before a selection of any known energy absorber can be utilized. This applies equally as well to the development of new energy absorbing materials. The weight of an item will always be a known factor. However, its rate of descent utilizing various methods of drop will have to be computed.

We then must determine the dynamic characteristics of the energy absorbing materials. In determining this, we must know:

1. The time during which the force acts.

2. The stress forces in the energy absorbing materials in pounds per square feet.

3. We must know the bearing area of the energy absorber in square feet.

4. We must know the stopping distance in inches or feet.

Last but not least, we must determine the maximum "G" force factors that all items individually will withstand without damage or destruction. This task is one of immense magnitude.

All material and equipment to be air dropped to our combat forces will have to have a rated maximum "G" force that it can withstand without damage of destruction.

Let us take one example: Let us say that a case of C-rations can withstand a "G" force factor of 20. In other words, it can withstand an impact force of 20 times its weight without damage. We know its total weight and we know its rate of descent; then we can compute the allowable stopping distance. In this case, let us say 9 inches. Anything less than 9 inches would impose an excessive "G" force factor on this item. The application of our findings on the dynamic characteristics of energy absorbing materials now comes into play. We then select the type of energy absorbing material having the dynamic characteristics which meet this requirement.

The most difficult portion of this over-all problem appears to be that of computing the "G" force factors on items; i.e., a case of rations, a case of ammunition or an item of equipment. These factors must be computed relative to all three axes of the item.

The determination of solutions to the factors that I have mentioned will lead us very close to the over-all solution of our problems, as they now appear to be, in our air drop activities. We know that maximum utilization and efficiency of our external packaging combined with the advantages of internal packaging will give us the desired results. We intend to solve first things first. The first in this case is the determination of the dynamic characteristics of energy absorbing materials. Second, we will look into the internal packaging problem in order to further assist us in the ultimate solution.

The absence of knowledge of the "G" force factors on any particular item will not slow us down. We will, if necessary, compute this by actual trial and error methods and establish acceptable "G" force factors in the absence of available testing equipment to do the job. Testing equipment is presently being developed that should assist in this program.

IMPLICATIONS OF PACKAGING IN AIR DROP ACTIVITIES.

Gentlemen, without the solution to the problems we have discussed in packaging for air drop, we are treading the borderline where excessive cost may preclude our ability to

support this modern trend of warfare. The cost is not entirely in dollars and cents. The cost is in manpower, both at home and in the combat area. The cost is in the use of our natural resources. Do you realize that the support of one ground division for one day of supply could conceivably require approximately 600 tons minimum? To deliver this tonnage would require 600 parachutes, 600 containers and miscellaneous items costing approximately $490,000. This does not take into consideration the manpower, aircraft and facility requirements for such a task. It is believed possible to reduce this cost, with effective use of energy absorbing materials, to approximately $80,000 or less.

Present cost of parachutes and containers require that they be recovered on the battlefield for re-use. The parachutes must be repacked, repaired if necessary, and re-issued. All these tasks require manpower and additional cost. The recovery of Quartermaster air type items can be eliminated if the cost in the loss of these items can be reduced to an area commensurate with the cost required to evacuate them to areas for re-use. In other words, it would cost you more to recover the item than to leave it on the field after use. Expendable items will provide the answer. Much the same as we discard the wrappers of our commercial products, we hope to discard items used in aerial supply. Packaging or energy absorbing materials will go far towards making this possible.

CONCLUSION.

The Army has developed techniques in order to make it possible to supply our combat forces in any inaccessible area. Our methods and techniques of aerial supply are adaptable to all types of cargo aircraft both of the U. S. Air Force and Army aircraft. We are continuing to develop newer and better methods and techniques for air drop.

The one comforting thought that we of the military have is that we are not alone in trying to solve our problems. We have industry to assist us. We welcome constructive criticism, new ideas, new developments, and new approaches to our mutual problems. I sincerely hope that this discussion will bring about continual and increased personal contacts between military and industrial representatives on this most important aspect of logistics.

Monday PM Oct. 10, 1955

A Gaseous System For Corrosion Control

Mr. T. J. Nussdorfer
Arthur D. Little, Inc. for The Bureau of Aeronautics

The preservation of metal parts with volatile corrosion inhibitors (VCI) is receiving increasing acceptance in the packaging field. Since these materials offer simplified procedures for wrapping and depreservation, the Navy Bureau of Aeronautics sponsored a program to evaluate commercial and new volatile inhibitors for packaging military aircraft engines.

Volatile inhibitors function in the presence of moisture and oxygen on ferrous metal surfaces, and thereby differ from the more familiar packaging principle designed to exclude moisture. The action is somewhat similar to that of a rust inhibitor in an automotive radiator, inasmuch as a film or coating of inhibitor forms on the enclosed metal surfaces and tends to insulate them from corrosive attack. However, instead of distributing the inhibitor by means of a liquid, volatile inhibitors depend upon gaseous diffusion of vapors.

The choice of volatile inhibitor is limited by the materials to be protected, as well as by the efficiency of distribution by gaseous diffusion. In some instances, a highly volatile material is desired for rapid distribution, but may be achieved only at the expense of long-term protection. On the other hand, where a slightly volatile substance will provide protection for a long period of time, corrosion may develop before adequate distribution is accomplished. Obviously, rapid distribution and long-term protection are not compatible in one material.

Although the program undertaken was directed specifically toward the Navy's problems in the packaging of military aircraft engines, several of the new developments uncovered might be applicable to problems in other governmental and industrial packaging fields.

VCI MATERIALS

Arthur D. Little, Inc., has compared the relative effectiveness of over 100 materials in protecting metals against corrosion. The good inhibitors seemed to have two characteristics in common:

1. An element or ion grouping within a molecule to make the substance capable of sharing electrons

with chemically active sites on the metal surface which might otherwise act as nuclei for corrosion.

2. A long chain or ring arrangement of carbon atoms to provide a barrier to the passage of moisture (a hexyl ring of carbon atoms seemed particularly effective in this respect).

Many of the salts formed from the reaction of an organic base (amine) with a weak organic acid satisfied these specifications; but with the added requirement of volatility, the field of investigation became considerably limited. It was noted that the reaction of acid with amine usually took place at room temperature, and suggested the possibility of injecting the constituents separately to form the inhibitor in place. Such a technique would have the advantages of using more highly volatile constituents (which are desired for efficient distribution) and of forming much less volatile inhibitor for long-term protection.

CYCLING CORROSION APPARATUS

Before an evaluation of these VCI materials for military aircraft engines could begin, however, a new method of evaluating was needed which would simulate the condensation of moisture on exposed surfaces during the night and the evaporation of that moisture during the heat of the day. The common salt-spray and humidity cabinets were unsatisfactory because specimens were continually dripping with water--an unrealistic condition for equipment in sheltered outdoor storage.

New equipment was designed to produce an environmental cycle similar to that produced by nature on an accelerated time basis. The atmosphere was maintained at a constant temperature and relative humidity, while specimen temperature was varied--first to produce a fine, even dispersion of water droplets, followed by a thoroughly dry condition. The air-dry-bulb temperature was set at 108°F and the dew point at 85°F (50 per cent relative humidity).

Temperature variations of test specimens during one cycle are presented in Figure 1. The evaporation period began with a one-hour gradual change from 85°F to 108°F and ended with a two-hour period at a constant 108°F to assure a thorough drying; the condensation period started with a one-hour gradual change down to the dew point and ended with a two-hour period at that temperature, thereby allowing time for corrosion products and electrical potentials to develop. It is important

TEMPERATURE VARIATIONS ON TEST SPECIMENS DURING ONE CYCLE

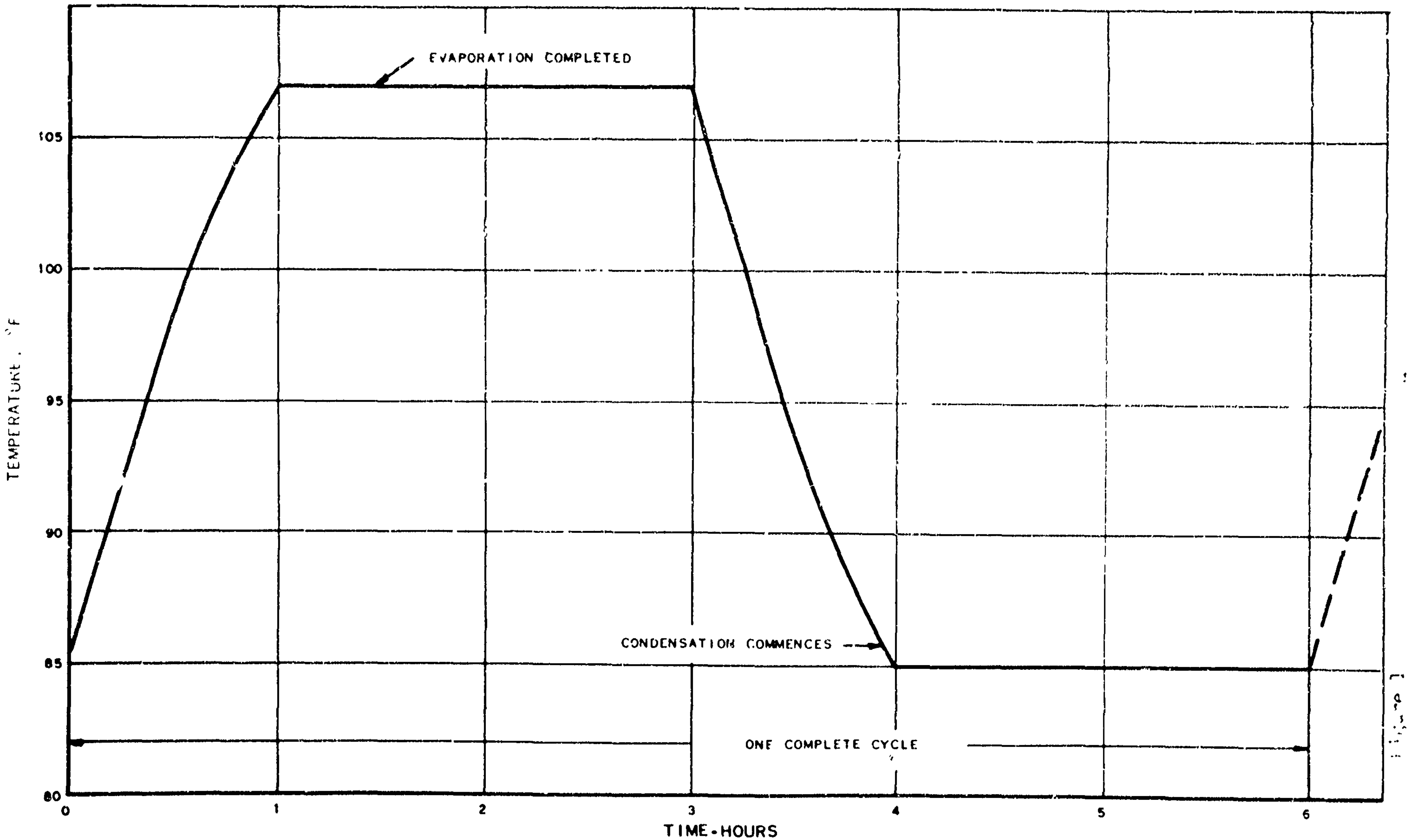


Figure 1

that the degree of condensation be so controlled that contaminants from either the atmosphere or from the corrosion process are not washed off. Figure 2 shows the quality of condensation produced on a test specimen.

This apparatus was first used to evaluate three methods of preservation for reciprocating aircraft engines:

1. Spraying cylinder assemblies internally with a lightweight preservative oil.

2. Using a volatile inhibitor by itself.

3. Combining 1 and 2.

The Navy Bureau of Aeronautics had initiated a field evaluation of the three methods at about the same time and thereby provided a correlation of laboratory with field results.

Since the cylinder walls of reciprocating engines were the critical areas to protect, it was necessary to obtain uniform and typical surface conditions within each cylinder by running them in on a single-cylinder engine. Figure 3 is a photograph of the six complete assemblies mounted in individual watertight boxes to permit circulation of water and the consequent control of condensation and evaporation. The air-conditioning cabinet was connected to each unit by ducts attached to the intake and exhaust ports, and the VCI material was distributed by the gently pulsing air circulating through it.

Results of the laboratory tests were in substantial agreement with field observations. The lightweight preservative oils showed adequate protection initially, but the continuous drain-off ultimately exposed areas vulnerable to corrosion. The volatile inhibitor (a commercial material) gave excellent long-term protection wherever it did not come in contact with the acidic residue from the combustion of leaded fuels. However, when the two methods were combined, the oil seemed to buffer the acidic deposits, permitting the volatile corrosion inhibitor to function satisfactorily.

GASEOUS INHIBITORS FORMED IN PLACE

As soon as it was established that the cycling corrosion apparatus provided a satisfactory means of comparing inhibitors for metals in sheltered outdoor storage, the study of new materials or combinations of materials and methods of application logically followed. One of the most frequent

CORROSION INDUCING CONDITIONS ON A JET-ENGINE COMPRESSOR BLADE

Figure 2

CYCLING CORROSION APPARATUS WITH CYLINDER ASSEMBLIES INSTALLED

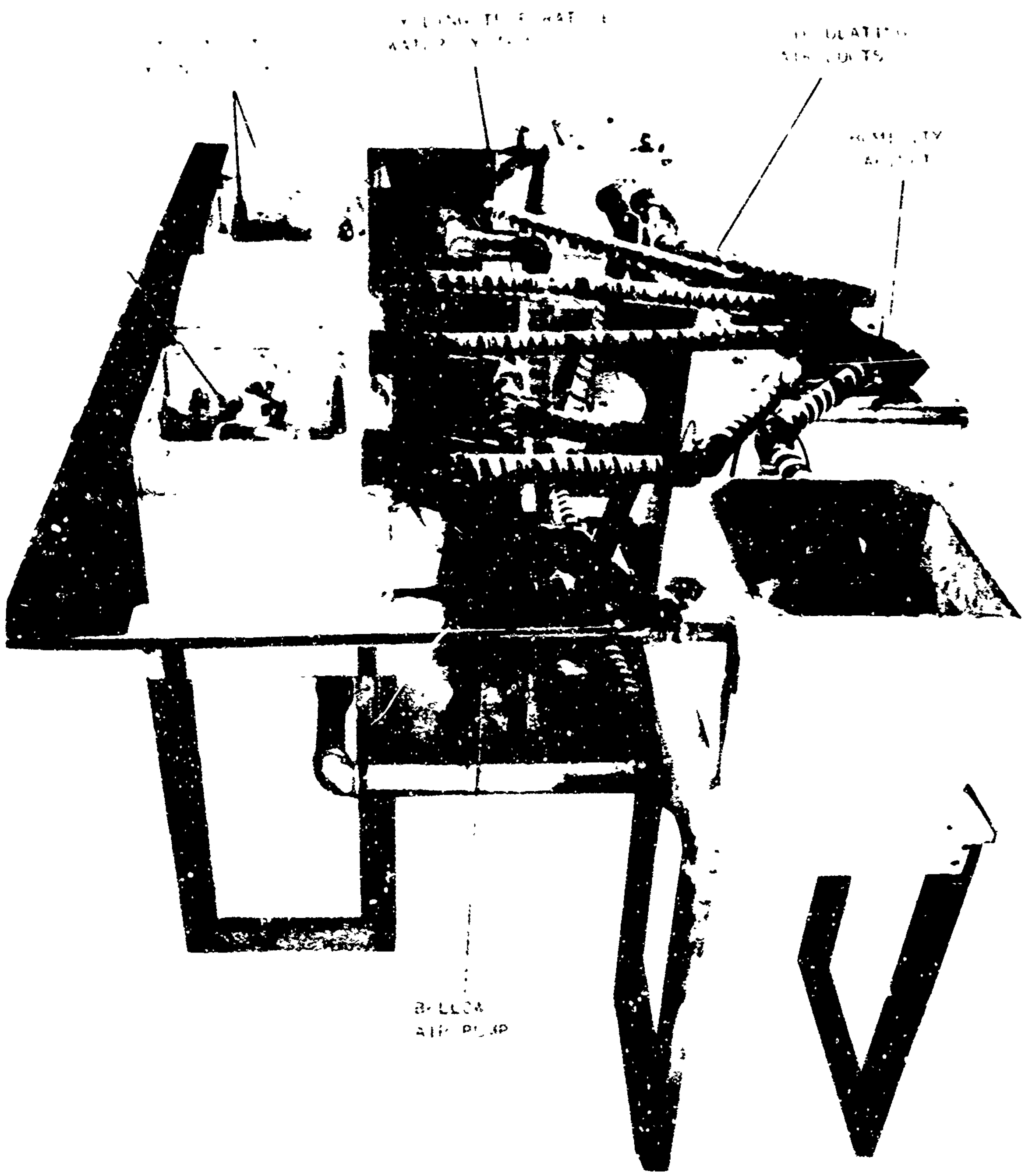


Figure 3

difficulties encountered with commercial inhibitors could be traced to an inadequate distribution system. Consequently, in an attempt to surmount this obstacle, the method suggested earlier of forming an inhibitor in place by the reaction of volatile constituents injected into the cavity was undertaken. The approach was applied first to reciprocating engines, and subsequently to turbojet engines.

Reciprocating Engines

It was proposed to dissolve naphthenic acid in engine oil and then aspirate each cylinder during shutdown. When the engine had cooled sufficiently, a small amount of volatile amine was to be sprayed into a spark-plug hole, the vapors of which would react with the naphthenic acid in the oil to form amine naphthenate inhibitor. Test cylinders were lightly oiled with a mixture of naphthenic acid and engine oil before installation in the cycling corrosion apparatus. Vapors of dicyclohexylamine carried by the circulating air reacted with the acid in the engine oil and formed a grease-like film. The excellent protection achieved was attributed both to the inhibitor formed on the surface and to the viscosity of the resulting oil film which caused it to adhere. Field tests of this technique have not yet been performed, but these tests have indicated it to be both feasible and economical.

Jet Engines

Corrosion in turbojet engines, particularly the axial-flow type, became a major problem for Navy carrier based squadrons. The salt spray sucked into the compressor section during operation attached the stainless steel blades and the aluminum and magnesium components. The standard maintenance procedure of spraying preservative oil into the front end of engines upon shutdown was tedious and not always effective, and uniform distribution ofoil into the rear half of the compressor seemed almost impossible. An inhibitor material which could be formed in place appeared to offer a simplified procedure for reaching the whole compressor section.

Many materials were applied to specimens cut from a typical compressor to determine their inhibitive effect. Figure 4 shows the method of mounting these specimens in the cycling corrosion apparatus. None of these inhibitors was satisfactory for all three metals in the presence of sea water. Cyclohexylamine car ate, a white crystalline material formed slowly from the gaseous reaction of carbon dioxide with vapors of the amine, provided excellent protection for the stainless steel. However, after a week's exposure, bare aluminum surfaces developed a thin green coating (apparently not an incipient attack) and the magnesium

CLOSE UP OF SPECIMEN MOUNTING SYSTEM

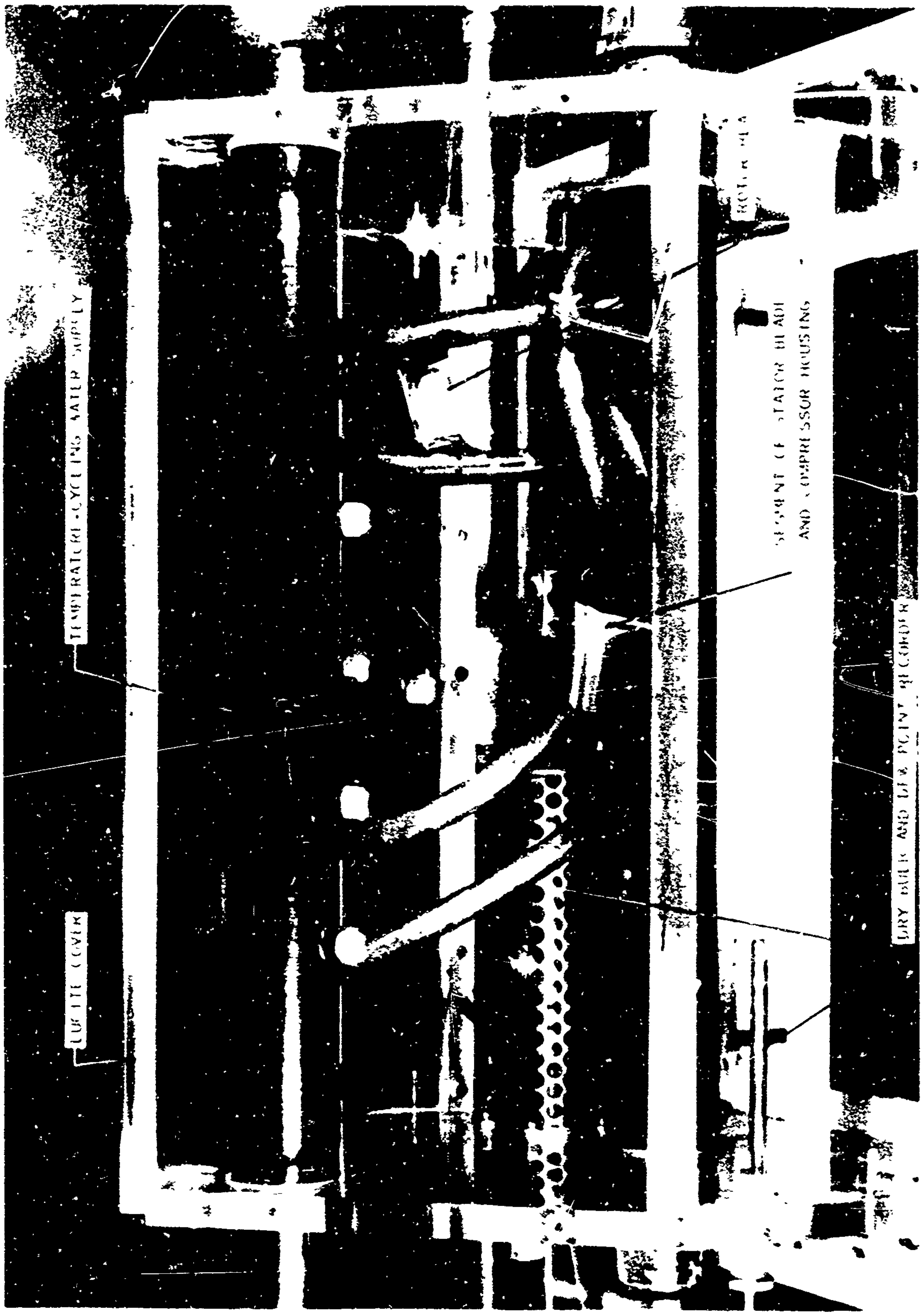


Figure 4

showed little if any protection. Experimental data suggested that cyclohexylamine (a liquid at room temperature with a vapor pressure near that of water) required some means of stimulating its gaseous diffusion process if rapid and efficient coating of inhibitor was to be realized, a result which was ultimately obtained using an aerosol application with a freon propellant.

Through the cooperation of the Quonset Point Naval Air Station, distribution tests on several axial-flow type engines were initiated. Excellent radial and axial distribution to both sides of the rotor and stator blades (Figure 5) was obtained by placing one aerosol can containing 60 grams of amine four feet ahead of the compressor inlet and three-quarters of a pound of dry ice in the engine outlet. Both openings were then sealed with vapor barrier material to reduce air circulation and inhibitor depletion. Since approximately three hours were required to establish a thorough coating, the dry ice source of carbon dioxide provided the slow injection rate found to be so important. When the gas was supplied from a cylinder, suitable throttling orifices were required to extend the injection period to about 15 minutes. Location of the aerosol source was also important. If it was placed too close to a surface, an amine-wetted area developed which formed a solid, white build-up of amine carbamate. Although subsequent operation of the engine removed the normal white, frost-like coating, the solid film did not disappear. When special nozzles which could produce a fine aerosol spray were used, the problem was less acute.

For actual field use of the gaseous system of preservation, pneumatic plugs are suggested to hold an aerosol can in place on the inlet cover and dry ice in the engine outlet after every operation (Figure 6). Cyclohexylamine is not the answer where magnesium corrosion is a serious problem. The answer to such corrosion prevention is still being sought.

OTHER APPLICATIONS

Other types of engines found in marine, farm, and highway equipment, for instance, are so similar to aircraft engines in construction that a gaseous inhibitor system should be equally applicable to them. Tankers and barges, which must make return trips empty, might use gaseous inhibitor constituents to prevent corrosive attack in the hold or other enclosed compartments. In the extensive layaway program for production equipment now being conducted, air-conditioned hutments are favored. This method is an expensive procedure. Since these hutments are constructed

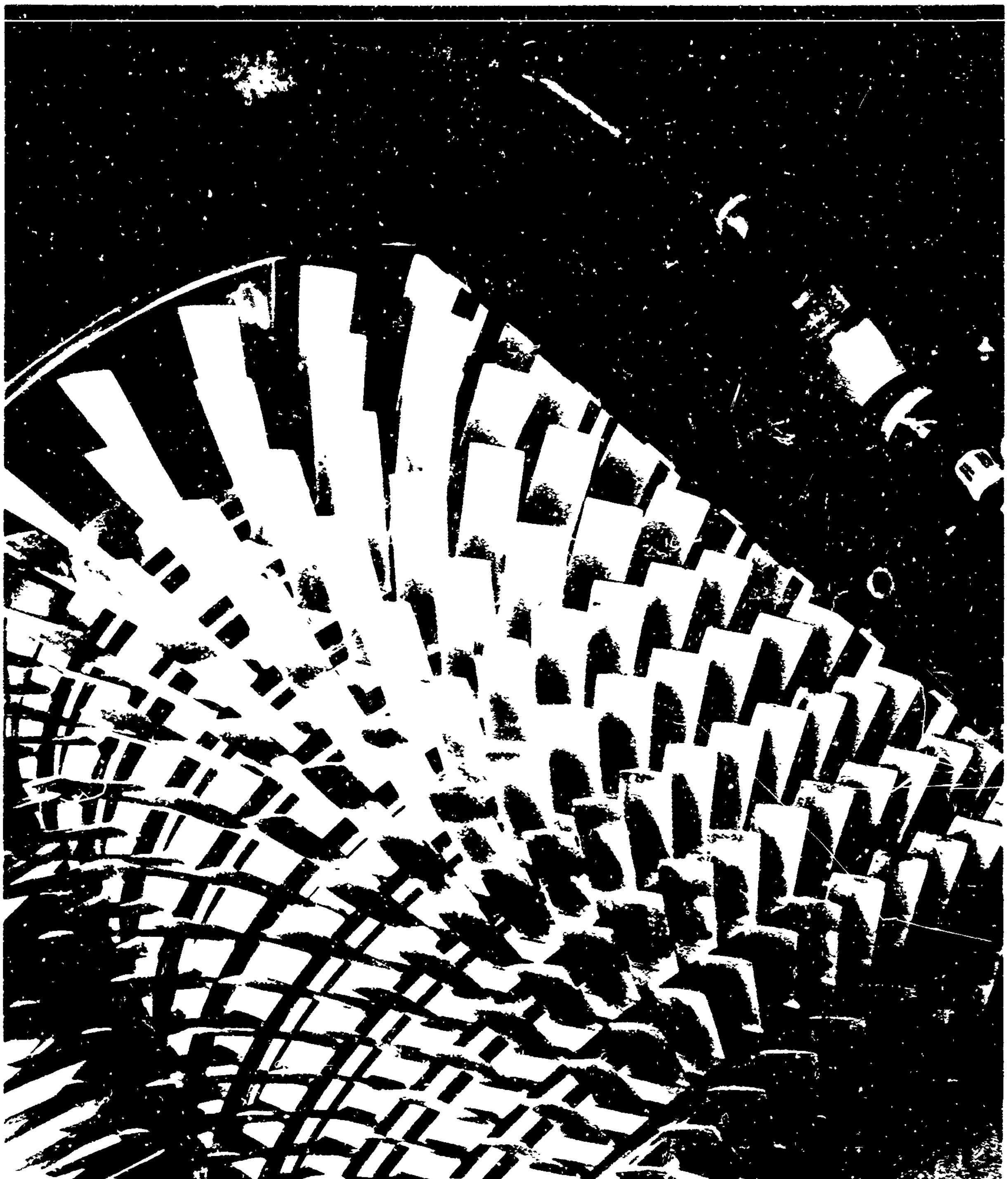
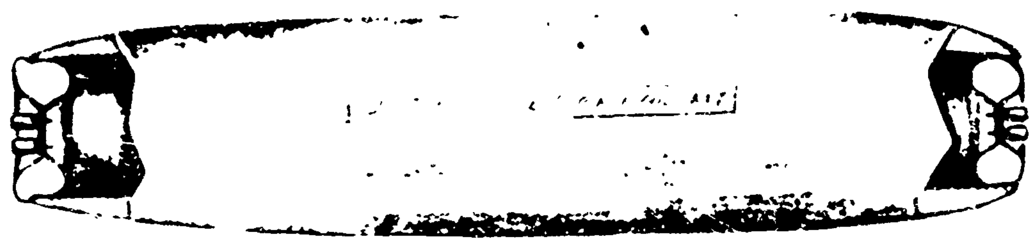


Figure 5

PROPOSED PNEUMATIC PLUGS
FOR PRESERVING INSTALLED TURBO JET ENGINES



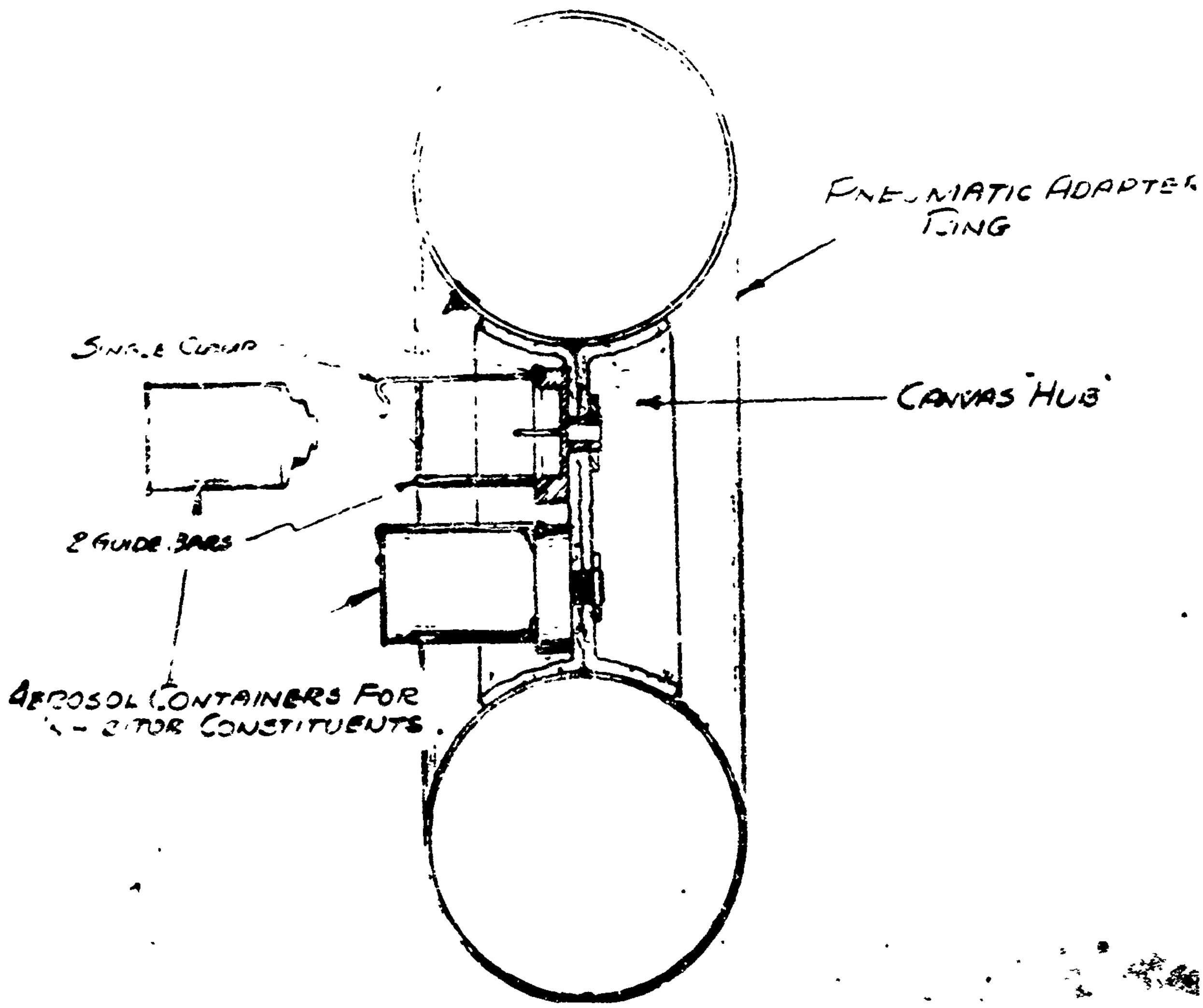


Figure 6

of vapor barrier materials, they would be well suited to the injection of gaseous inhibitor instead. Many different VCI papers are available commercially, but they are suited only to small packages. Any critical areas located more than 12 inches from the source of inhibitor cannot be protected. If the paper could be impregnated with more volatile constituents, speedier distribution and greater depth coverage would be possible.

LIMITATIONS

Before it is decided that a gaseous system is the cure-all to the preservation problem, there are difficulties which must be resolved before attempting full-scale use. There is no convenient way of estimating the dissipation rate of the inhibitor or the time when it probably will be no longer effective. Furthermore, some inhibitors for ferrous metals may attack non-ferrous metals such as copper, lead, cadmium, and zinc; however, corrosion may be reduced or eliminated by the presence of a heavy mineral oil or proper choice of inhibitor. Non-metallic materials such as rubber and plastic compounds are also subject to deterioration. It is imperative, therefore, that all materials which may be exposed to the volatile constituents be considered in the selection of a suitable inhibitor system.

It may be stated, however, that insofar as definitive means of protection have been established (i.e., for ferrous metals), such a preservation procedure is both simple and economical.

Monday PM Oct. 10, 1955

"Temperature Controlled Packages"

Lt. Donald S. Martin
Wright Air Development Center, Dayton, Ohio, U. S. Air Force

Last year the dollar volume of temperature critical products was in the billions. By temperature critical I mean those shipments where temperature must be controlled in a more narrow range than the extremes of environmental ambient temperatures encountered in the transportation. The great bulk of these shipments are moved by commercial refrigerator car and truck. However, there are instances where, because common carrier facilities are not available or a complicated distribution set-up is involved, that it becomes economical, and even necessary, to provide a self-contained package.

Arctic Food Pack

The Air Force recently faced this problem in the shipment of fresh fruits and vegetables in the Arctic. For purposes of morale the Alaskan Command has been most anxious to supply troops in outlying radar and weather stations with fresh foods like tomatoes. Low ambient temperatures in the Arctic of -65° F and below during the winter months, however, would quickly freeze the tomatoes when they are exposed to these conditions during handling operations. If you have ever eaten a thawed tomato you know it is not very palatable.

Consequently the following criteria were established for the development of a suitable container:

1. To provide protection against freezing for a period of six (6) hours at an ambient temperature of -65° F.

2. To be able to be handled by two men with a weight not to exceed 100 lbs loaded.

3. To be of low tare weight for air shipment, and, if possible, to be expendable.

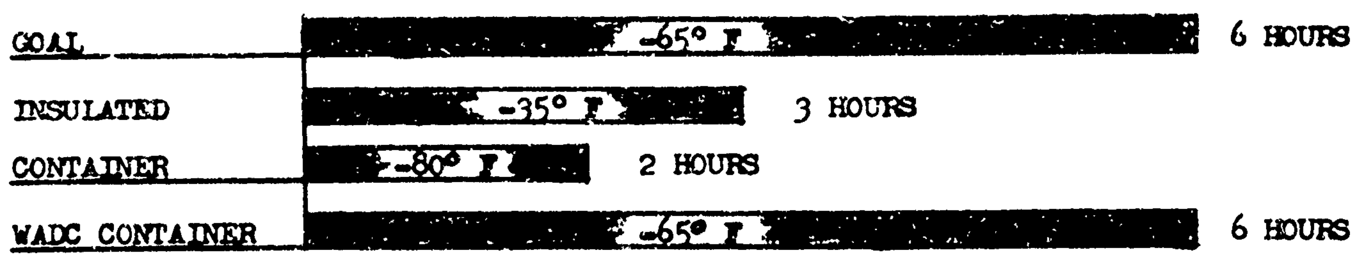
Insulated Containers

Several proprietary containers employing thermal insulation were submitted for evaluation. The most successful of these employed six inches of fiberglass insulation to retard heat flow. When placed in a cold room at -35° F failure occurred after approximately 3 hours. At -80° F failure occurred after approximately 2 hours. It should be noted that this result was achieved at a cost of roughly 85% of the container cube in insulation material. Pertinent data is summarized in Figure 7.

Figure 7

ARCTIC FOOD PACK

TEMPERATURE - TIME REQUIREMENT



TARE WEIGHT AND CUBE

	PAYLOAD	TA[illegible] WEIGHT	CUBE
INSULATED CONTAINER	2 cu ft	67 lb	12.8 cu ft
WADC CONTAINER	2 cu ft	43 lb	3.0 cu ft

Figure 8

The proprietary containers submitted relied on the principle of retarded heat transfer by use of insulation. This was a different assignment for insulation materials, since the temperature range of the tomatoes during the test was a narrow one. The tomatoes were packed at 38-40° F, which is normal storage temperature used to prevent spoilage of ripe tomatoes. On the low side tomatoes freeze at 30.4° F. An additional factor was the poor heat flow within the packed tomatoes. Tomatoes in the interior of the pack remained essentially at their initial packing temperature throughout the test.

Consequently it appears that the insulated container failed when the sensible heat of the outer layer of tomatoes had been depleted to the 30.4° F level.

Heat of Fusion Container

As a result of the failure of insulated type containers to solve the problem, a new approach was attempted utilizing the latent heat of fusion of water. A load of tomatoes conditioned to 38-40° F was packed in a corrugated fiberboard box and the box enclosed within a heat-sealed flexible water-vaporproof barrier bag. A layer of water (20 pounds) was placed completely around the tomatoes by saturating a one inch thick layer of cellulose wadding. The resultant pack was then placed in a corrugated shipper lined with another flexible barrier bag. (See photograph, Figure 8).

This method of packing when subjected to -65° F for six (6) hours afforded the tomatoes complete protection. This protection was achieved (using the insulated type container described earlier as a basis for comparison) at a saving in tare weight of 35% and a saving in cube of 75%.

Theory

In principle, once the sensible heat of the water layer was dissipated, the water underwent a phase change liberating a latent heat of 2880 BTU (20 pounds of water). The water, to use an analogy, may be thought of as a heat battery of 2880 BTU capacity which supplied the heat current required through the walls of the container until all the water was frozen.

By varying the insulation qualities of the container wall to alter the flow of heat and using more or less water in the heat battery, protection for different time periods may be obtained. For the Arctic Food Pack a quantity of 2 pounds of water per square foot of shipping container surface was sufficient.

Lt Donald S. Martin, USAF Monday PM Oct. 10, 1955

Application

Utilization of the latent heat of fusion is, of course, not new. Some florists I am told, in shipping flowers from Florida to cold northern climates by air, will wrap their flowers in wet newspaper.

The system chosen need not be water-ice, and indeed a system should be chosen such that the phase change occurs within the viable or storage range of the item. For instance the shipment of live tissue culture used by the National Foundation For Infantile Paralysis in its nationwide evaluation of Salk vaccine required temperature control within the rante of 37 to 100° F. For protection of summer shipments, New York University investigated a salt-hydrate system with a melting point of 88-90° F and was successful in providing the required temperature control. 1/ The application of this principle to the shipment of biologicals in general is obvious.

Summary

Application for self-contained temperature controlled packages are numerous. It is suggested that a fruitful avenue of approach, especially where critical temperature ranges are narrow and extreme ambient temperatures are encountered, is to investigate the use of the latent heat of a physical change of state.

1/ Temperature Protection of Packages - A report to the National Foundation for Infantile Paralysis, New York University.

Program for the Second Day

Tuesday, October 11, 1955

Mr. Charles F. Honeywell, Administrator
Business and Defense Services Administration, Chairman

Tuesday AM Oct. 11, 1955

Materials Handling and Warehousing Operations

Mr. W. L. Pearce, Assistant Manager, Parts Distribution
Chevrolet - Flint Manufacturing Division
General Motors Corporation

The importance of the inter-relationship between material handling, warehousing, and unitizing is something that was overlooked for an extended period. Realization of its importance came only when it became necessary, because of increased volume and rising costs, to do something about the problems of efficient space usage and material handling.

To accomplish at least some of the basic requirements, A study of the problems involved was instituted by the Flint Parts Distribution Department of the Chevrolet Motor Division, of General Motors Corporation. Many improvements have since been developed and substantial savings realized together with better distribution and more satisfied customers.

The Parts Distribution Department at Flint operates under the jurisdiction of the Chevrolet General Manufacturing Manager in Detroit, and has full responsibility for inventory control of Chevrolet, Oldsmobile and Pontiac parts at all 41 warehouse locations.

This Department also has full responsibility for the operation of the five major supply depots located adjacent to manufacturing or assembly plants and the maintenance of inventory control records at MSD'S for all warehouses including those at sales zone locations.

In order to make our operations and material handling problems more understandable to those in other organizations, a few facts are presented with technical detail eliminated to the greatest possible extent.

Parts used on Chevrolet vehicles only, or interchangeably on Chevrolet, Oldsmobile and Pontiac vehicles comprise the largest number of directly controlled items and will be used as the basis for operational descriptions in the balance of this outline.

Service parts fall into three stockage categories; Code Z or fast-moving parts stocked at all 41 warehouses; Code M, slower-moving parts stocked at 11 master warehouses and Flint; and F or factory parts, very slow-moving or bulky parts stocked at Flint only. As of October 1, 1955, the spreads of these Chevrolet and Chevrolet interchangeable parts were as

follows:

Code Z	1,918
Code M	7,210
Code F	19,443
	28,571

Since 1947, the major supply depots including Flint have averaged shipments of 350,000,000 pounds of parts a year.

In 1954, at Fling only, 3,094 full rail cars of material were received and 4,351 shipped. Receipts and shipment by truck and other means are not included and these figures represent actual cars only. Total weight shipped from Flint in 1954 was over 147,000,000 pounds, a sizable material handling job.

Material handling in the warehouse is a very broad subject that covers practically the entire warehousing operation. We do more handling of material than any other single operation. From the time material is received and unloaded, we begin handling material and continue to handle it for the receiving, inspection, storing, picking, packing, and shipping operations. Even the packaging, unitizing and processing operations are another form of material handling.

In a parts warehouse operation, there are many other factors that enter into the materials handling function.

Generally speaking, you will, in all probability, find the handling of large, heavy or bulky parts reasonably efficient for these are the big items we stumble over and can more readily see ways and means of improving.

I would like briefly to review with you some of the more obvious improvements in material handling of the larger items.

When space is at a premium, we are usually forced into many extra material handling operations. To better illustrate this point, we would like to first present the old and then the improved method of handling some of the more difficult bulky items; namely, sheet metal items.

The operating cycle on raw sheet metal items, such as the fenders was to -

1. Unload from car or trailer onto flat truck.

2. The truck was taken to the storage area where the material was unloaded and placed in wood racks or

piled on the floor.

3. When required for processing, this material was removed from the wood racks, placed on the flat truck and pushed to the paint department for priming.

Time studies revealed that 54 man minutes of materials handling were required to complete this cycle.

This storage and handling problem was solved by the use of what we call "air rights racks".

This rack consists of a base and end frames. The base is 44 inches wide and 80 inches long and the end frames are 23 inches high. By inserting the end frames into the base, we have half the unit assembled. This size is suitable for certain types of material.

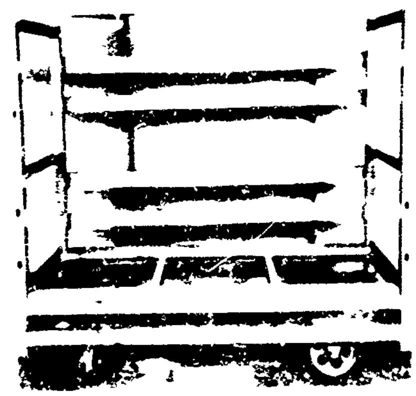
By inserting two end frames into the base unit, we have a 61½ inch high rack. The outrigger bars are added, as required.

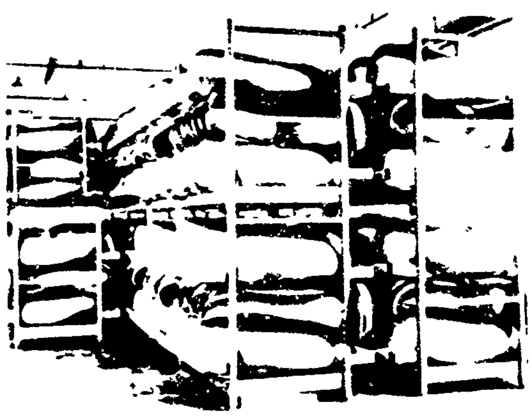
The air rights rack unit is placed on a dolly to facilitate movement when unloading the trailer or a boxcar and movement on the dock to the elevator and to the storage area.

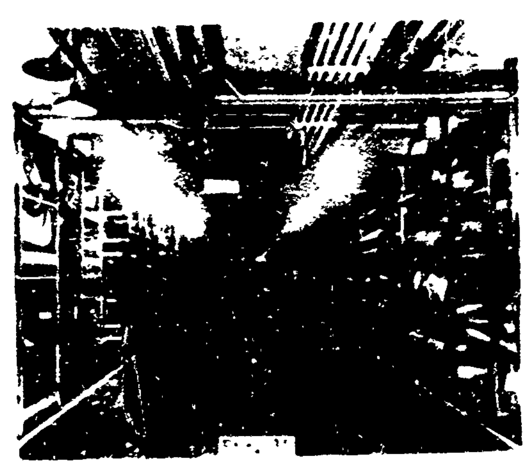
The use of these racks has eliminated the two handling operations of unloading the fenders from the flat truck and placing them in storage with extra men required on high piles and the operation of again loading on flat trucks when transporting to the processing department. One man with a fork truck can do in three minutes what it took two men 27 minutes to do.

Now, we can take full advantage of the available floor space and take advantage of our air rights without the costly piece by piece handling under the old method. With air rights racks, it makes very little difference if a rack of hood halves is stored on top of a rack of fenders. Like-wise, it makes little difference if one item is piled in the back and another item in front for in a matter of a few minutes, one man and a fork truck can remove any rack of piled material. You can readily realize that inventorying material stored in air rights racks is far simpler.

In this arrangement, there is very little waste space and in addition, we have a larger aisle to operate in and actually have more square feet and cubic feet of available







storage space than formerly.

Air rights racks are not a one-purpose rack. Examples of other types of material that can be stored to advantage in such racks are hood halves; gravel deflectors; which are a light sheet metal stamping; grille mouldings; cushion springs; and other irregular-shaped parts which are difficult to stack.

Throughout the years, we have tried many different methods or systems of storing parts in bins.

The division location system has been developed so that parts are grouped together in bins in the same rotation they appear on dealers' monthly order pads. With the stock arranged in this manner, the picker merely goes up one aisle and down the other to pick the dealer's order.

It has been our experience that as much as 40% of bin area can be saved over other bin systems by grouping bin sizes together.

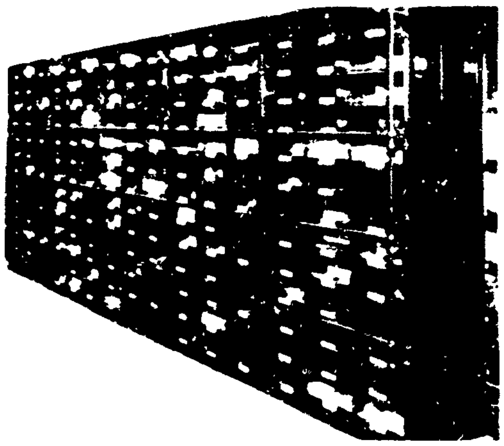
Another important advantage is that the reserve bins for expansion may be distributed as desired and required throughout the various bin size groups.

If a larger bin is required, part is relocated in larger bin size. When bin is too large, the part is moved to smaller bin. In our opinion, i is cheaper to move parts to proper bin size than to rearrange a bin tier or tiers to make the right size bin for the part in the location it must be maintained because of the binning system used. In grouping the same size bins together, all items must be located and a location file maintained.

Many years ago, Chevrolet developed removable box bins in three different sizes -- 4" x 5" x 9"; 6" x 6" x 12"; and 12" x 6" x 12". The small-sized box bin could be stored eight to a 36" shelf; the second size six to a shelf and the third size three to a shelf. This makes it very easy to rearrange the box bins so that they can be maintained in part number sequence and to provide reserve bins for expansion purposes.

Another very important phase of materials handling is "unitizing." In Chevrolet; we have a very extensive unitizing program.

Over a year's study went into the new package design adopted by the General Motors Parts Division. The function of



ECONOMICS OF
UNIT CONTAINER HANDLING
VS.
MASTER CONTAINER HANDLING

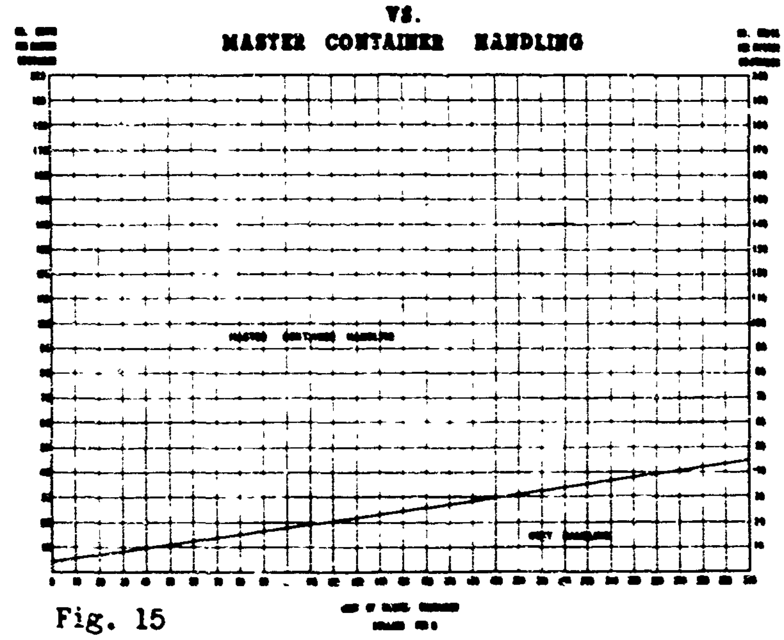


Fig. 15

package design was reviewed, along with the strong and weak points of the proceding design. There was long and painstaking study of color combinations, copy and identification arrangements, treatment of size variations, and plate and painting costs before management selected the new design.

In the replacement parts business, most of the smaller parts are unitized individually, or in multiple quantities. As a result there are many small packages involved. The receiving, storage and shipping in turn intensifies the materials handling.

"Master" packing, or placing a predetermined number of unit containers of the same part numbers in a standardized shipping container, substantially reduces the number of individual units to be handled.

For many years, we have used master packs, but in numerous instances, these had been established on the basis that the amount was satisfactory for shipping purposes alone. Some instances of unbalanced stocks resulted, as with 41 warehouses serving territories with varied car population densities, master container quantities would be satisfactory for some and too large or small for others.

Costs present further basis for study and occasionally it was discovered that the expense in handling the master containers was greater than handling separate unit containers.

For a considerable period, actual stop watch methods of time study were used to determine standard handling times for small, medium and large parts and containers.

Costs for the different methods compared were totaled and in many instances there was considerable variation. By means of algerbratic equations, a definite relationship between carton cost and the amount of material contained was determined. By adjusting the value of the two factors, the points at which the costs of the diverse methods broke even are readily determineable. Plotting these points and connecting them with a straight line produces a "break even" graph.

Usage of this graph is very simple. First, it is necessary to arrive at the proposed master pack quantity and then determine the cost of the master carton based on a square foot of board stock.

Then, if the point plotted as a result of applying these two values is above the line, it may be assumed that the pack is economical. If below, the reverse is true.

If volume is sufficient, master pack items can be palletized to further reduce material handling.

From a size standpoint, many items would make good master packs but because of the weight of the individual part, it is not practical to master pack.

We have many in-between parts that are too large or too heavy to be master packed and too small to be palletized, such as transmission gears and shafts, ring and pinion gears, universal joints, carburetors, and many others.

Either because of the sales volume, weight or the size of binnable parts, we find that we have a lot of large bins and many parts that need several large bins or other containers to store our normal bank stock. Some of our packaged parts are in small chipboard containers while other larger or heavier parts are in small corrugated cartons; such as water pumps, brake shoe sets, gears, etc.

There still is a lot of materials handling in the movement of parts too large or heavy for master packs and too small for pallet packs.

Many of these parts were stored in large bins and pallet boxes, or piled loose in piling racks. Realizing these types of items presented a materials handling program, we began searching for a better method. Our present warehouse layout and storage equipment were planned, designed and completed prior to pallet programs. Our present piling racks do not lend themselves too well to the storing of material in pallet containers in the most efficient manner, so that material in pallets stored in our present piling racks is not readily accessible.

It seemed to us that the basic principle of flexibility of the small box bins is ideal, and when applied on a larger scale with properly designed pallet containers, racks and fork trucks we should have all the tools to do the job.

I would like to review with you some of our requirements of a pallet container that would have the same relative flexibility of the box bins:

Substantial
2,000 pound capacity
Collapsible
Stack well

Correct size for box cars
Correct size for trucks
Pick stock when stacked
4-Way entry for fork truck or pallet
dollies

Several years ago, while attending a materials handling exposition, I saw some pallet containers that in principle offered possibilities of solving some of our problems. Whenever the subject of pallets or pallet containers comes up for discussion in a group of materials handling engineers, one of the first questions on the agenda usually is, "what standard size do you use or recommend?" That is the signal for a long and heated discussion, with the usual result we have no standard and the sizes used by the different industries are many and varied; some of the more popular sizes being 40 x 48, 42 x 48, 36 x 48, and 48 x 54.

The question of what is the right size pallet container for our operation was turned over to our Planning and Research Department, together with the problem of designing or obtaining pallets and racks or other necessary companion equipment.

The receiving warehouse uses this information -

Unit & shortage code
Part no.
Part name
Quantity
Order no.
WH location
Tag for receiving checking
Tag for shortage release

Reaction in the stockroom was pronounced as for the first time a really legible tag was available and the tedious locating as classifying operations were eliminated.

Pallet boxes are placed at the ends of bins and identified as to warehouses and freight classification. Parts are packed directly in the pallet box with small parts or quantities in salvage cartons and placed in pallet boxes. These salvage cartons save materials handling when received at zone warehouses.

This close up will give you a little better picture of the packing arrangement and use of salvage cartons.

The results were more than gratifying with the bottleneck bogey overcome.

In addition to the materials handling savings, substantial reductions were made in shipping supplies.

Current developments include segregation of tags and printing separate listings of "loose" material which include piece weight greatly simplifying estimating total weight and later preparation of bill of lading.

It may be of interest to remark that volume of material now being handled is the greatest in our history and operations are being carried out on schedule in spite of the fact that very little additional space has been made available.

Our research revealed that a pallet container 32 x 40 x 28" was the ideal size for our operation. On the 32" dimension it will go three across a box car and on the 40" dimension, it will go two across a truck, while the 28" height makes it easier to reach into the bottom. Being longer on one dimension, it will accommodate a more varied assortment of unit containers and permit varying loading arrangements within the container.

With the overall size established, our Planning Department went to work on the problem of picking parts for stacked containers.

During this research program, they designed several different styles and sizes of containers and racks.

For experimental purposes, we had eight of these containers made up, four with the stock picking door on the 32" side and four with the door on the 40" side. Incidentally, as far as we know these were the first of these steel wire containers made with a picking door.

These containers stack nicely and stock can be picked from the first two. Stock can also be picked from the third container with a short ladder; however, the top tier is used for storage only and not for picking purposes.

If cartons are too large to be removed from the picking door, the whole end panel can be folded back along the side to permit picking the larger cartons from one end of the pallet container.

Finalization of the design for the pallet container was attained after continued research which indicated conclusively

that a 1/2 drop door was best suited to our needs. Redesign of the legs for proper clearance and a framework to support the mesh on four legs instead of six furnished a container that met all requirements in our operations.

These steel containers offer us the advantage of being able to remove parts while the containers are stacked, without benefit of any piling rack or any lost cube; however, when any but the top containers are empty and it is desired to remove them it is necessary that those on top be removed first so that the empty containers can be replaced with full ones.

To provide greater flexibility for replacing empty containers, a new rack was designed which permits the removal of any container from the rack in which it is stacked regardless of its location and replacing it with a loaded container without moving any of its neighbors above or below.

In order that you may better visualize the final container design, some slides are presented for your consideration.

This is the design of the pallet container completely setup. This pallet container comes closer to answering all of our requirements than any we had seen to date. You will note the four cast legs.

The drop front door will permit picking parts when stacked one on top of the other or placed in racks.

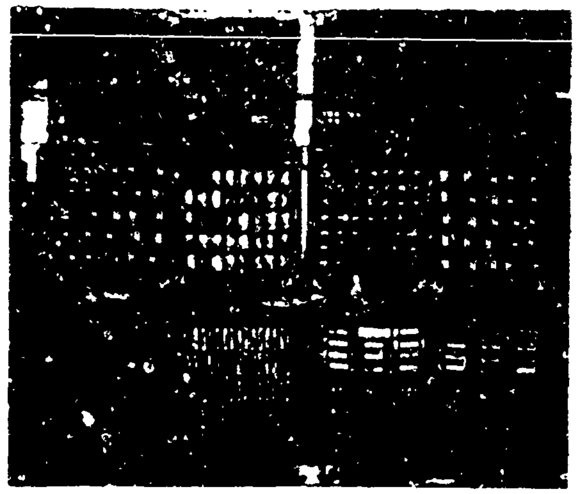
While the development and improvement of the pallet container and storage racks was progressing, we were deeply concerned with additional aisle space required for available fork trucks to tier this type container or place them in racks.

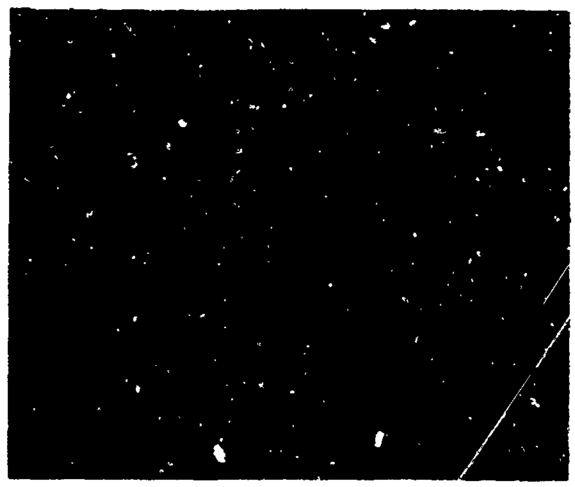
We were crowded with 6' aisles -- what would happen with 8' aisles? It's one thing to start out in a new building and layout with 8' aisles and quite another to expand from 6' to 8' with no extra space to spare.

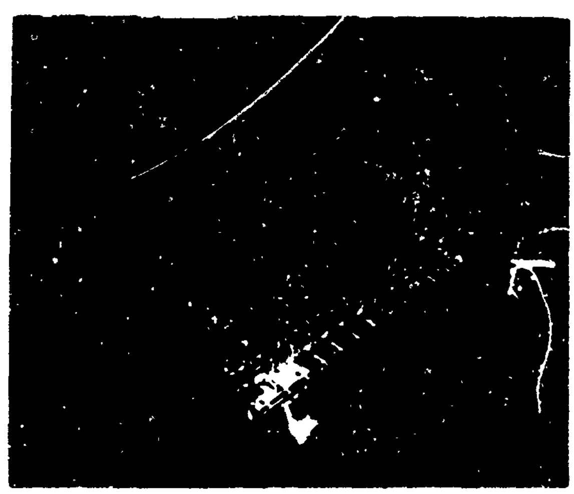
From a materials handling standpoint, it looked like a good program but from a warehouse space point of view, to say the least, it left a lot to be desired.

The problem was put up to several fork truck manufacturers who appreciated the problem but offered no solution at the time.

To make a long story short, our planning and research







department developed a walkie-type retractable fork pallet stacker that stacks 32" x 32" x 32" pallets in a 6' aisle and on the 40" dimension of the 32" x 40" in a 6'6" aisle.

This truck was awarded 2nd prize in the materials handling competition at the Philadelphia Convention of 1950, of the Society of Industrial Packaging and Materials Handling Engineers.

At a later date, an industrial truck manufacturer developed a riding type of truck that would work in narrow aisles similarly to the walkie-type retractable fork pallet stacker that we had designed and put to work. From our viewpoint, the availability of this truck was most timely, as it fit right in with our pallet container program.

At this time, it might be well to hesitate a moment to see just how this development affects the all important space factor in the warehouse.

An eight foot aisle is about the minimum that can be used in which to maneuver either a 2000 pound conventional fork truck or one of the walking type tiering trucks. In area #1, the aisles are 8' and only seven are available. Along the aisles, we can place only 90 units of storage. This aisle can be narrowed down to five feet if we place our containers on a sufficient angle; however, a lot less storage area would be available. By increasing the angle, and enlarging the aisle to 6' one more tier of storage was provided for. The aisle width in area #2 is two feet less than the 8' in area #1 but one additional aisle or a total of 8 are required with the result that the aisle area is increased to 1,104' with the units of storage reduced to 80.

Actually, we would be better off to maintain eight foot aisles as in area #1 when 90 units of storage were available in the same square foot area as compared to 80 units with six foot aisle area as in area #2. This, more or less, exploded the theory that the containers should be placed on an angle in order to reduce the aisle space required.

In area #3, the six foot aisles have been increased to 6'6" and in the same total area of 1,899 square feet, we are able to place 102 units of storage or 22 more units than with the six foot aisles with containers placed on an angle and 12 more than with an eight foot aisle. Actually, these are units of storage on the floor which could be increased three or four times, depending upon the ceiling height available.

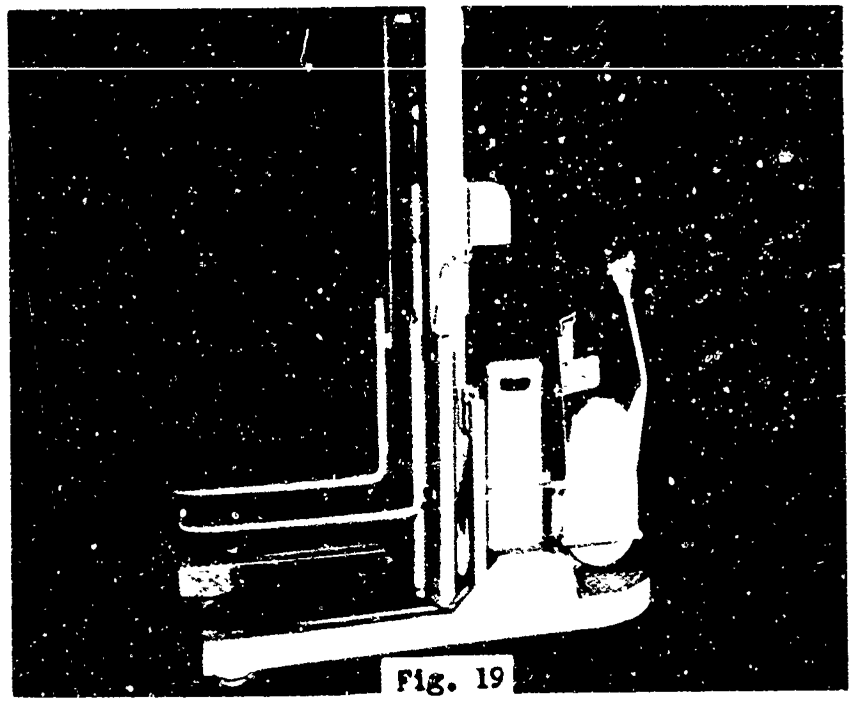


Fig. 19

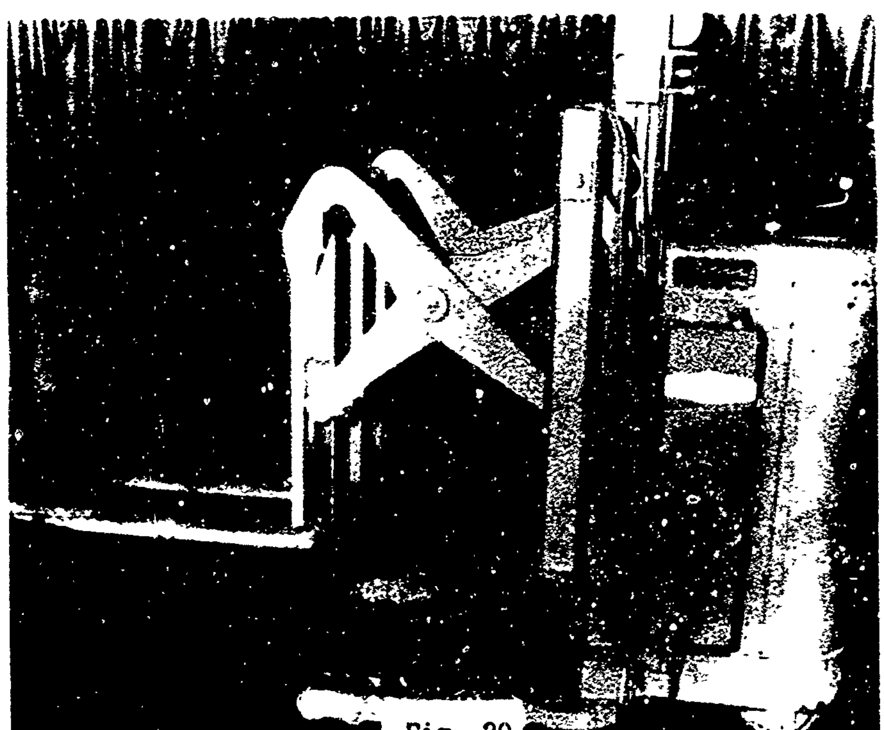


Fig. 20

The use of racks provides greater flexibility for replacing empty containers, as the racks permit the removal of any container without moving any of its neighbors above or below. You can readily see the flexibility of the use of these steel wire containers. A program of this kind can be started without benefit of any racks, and material can be removed very readily from the lower containers and from the third and fourth container if a ladder is used. If, when containers are stacked one on the other, it is found that too many of the higher containers have to be removed to replace lower containers, racks can be obtained and installed later.

Within a given area, more containers can be stored by stacking one on the other than can be stored in racks. The

pallet containers in the first and second tiers of the racks will be active-working stock and only one pallet container will be placed in these two tiers as the reserve stock will be stored in bulk storage area four high.

I will now give you a comparison of the former method and present method, so that you can better visualize materials handling in the new method.

In most unitizing operations, particularly after the final closure, the operator has time to place the carton in the pallet container instead of just pitching it in the gondola. The truck travel time will be the same whether the operator is transporting a gondola or pallet container. The speed of electric trucks in moving pallets or gondolas was determined by actual stop watch methods over a considerable period of time to obtain actual averages of various loads under various traffic conditions.

For comparison purposes, we have shown on a graph, the travel time for a flat truck pushed manually so that in the event any manual trucking operations were used, the graph would display the comparison. The present method with the pallet container entirely eliminates the manual piece by piece handling from gondola and placement into box car.

One graph shows how rapidly a car can be loaded with a fork truck as compared to the piece by piece manual method. The pallet container permits rapid loading and an early dispatch of the car, affords better protection and requires less dunnage. Pallet containers permit rapid unloading and make available extra car spots without the added expense of building an extension to the dock which, in many cases, is not possible.

You will recall that earlier I stated that it would take one man a week to unload a car with many small packages whereas with the material in pallet containers, and moved by fork truck, the car can be unloaded in approximately 30 minutes and a new car ordered in on the next switch.

The manual handling shown on our graph is comparable to the loading operation. Likewise, the transporting of the cartons from the car is comparable to transporting to the car.

The most important phase of this whole program is the fact that the container used for transporting from the supplier now becomes a stronge bin which eliminates the piece by piece removal from gondola and placing in bin. When

the bin being used is at the top of the tiers, and it is one of those large, deep bins that two men are required to store at least a portion of the material being put away, our saving is substantially greater.

Our graph shows that the manual handling time of placing the material in the bins is much greater than the time required for the manual loading and unloading operations.

Pallet containers and tubular storage racks are far more flexible for storage use than placing parts in large steel bins and wood pallet containers stored under steel racks. Just consider at inventory time the savings that can be effected with the rapid counting of cartons stored in pallet containers which can be accomplished without removing any of the cartons from the pallet container as compared to the necessity of removing at least a portion if not all of the cartons in a large bin or wood pallet box.

This program was begun with some of our Chevrolet-Affiliated Manufacturing Plants in Detroit, Saginaw, Bay City, and Flint. We expect to continue to expand this program; however, perhaps the most important factor governing this expansion is the freight factor -- that is the cost of transporting the pallet container on the outbound shipment and the cost of returning it.

You can readily understand that the more pieces transported in a pallet container, the greater the savings in labor; for we save, in transporting a thousand pieces, twice as much as in transporting 500 labor-wise, which must be compared against the cost of the constant freight factor on the out and inbound movement of the pallet container.

The freight factor, as we know, very definitely limits the area in which we can use these improved materials handling methods, for I am sure you will all agree that certainly there is no point in effecting savings in materials handling and then pay out more in freight costs than we save.

If the freight factor does not permit starting of this pallet container program at the source, we can at least do the next best thing and start it at the receiving dock or in the box car so that we can still take advantage of improved materials handling in transporting the material from the Receiving Department to the storage area and eliminate the manual operation of placing the parts in bins.

With the advent of this program which saw loose and

packaged material shipped from source in steel wire pallet containers, a definite need was found for a method of determining the economic dividing line of what material should be handled in pallet containers, and what should be handled loose as in the past. Obviously, if the cartons were large enough so that only four could be placed in the pallet container, our savings in handling would be offset by the freight factor. To be effective, this method would have to substitute scientific fact for "rule of thumb" or arbitrary decisions.

It was determined that a straight line relationship exists between the pallet container transportation charges and the number of pieces handled in a single container, which could be plotted on a graph.

To determine whether an item should or should not be handled in a container, it is only necessary to plot the point for the intersection of the container freight cost and the quantity of material accommodated by the container. If the point appears above the break even line on the graph, the item should be handled in a pallet container, and if below the line, it should be handled loose.

As the transportation costs go up, more and more pieces are required per container in order to effect a sufficient savings in material handling costs to offset the transportation costs.

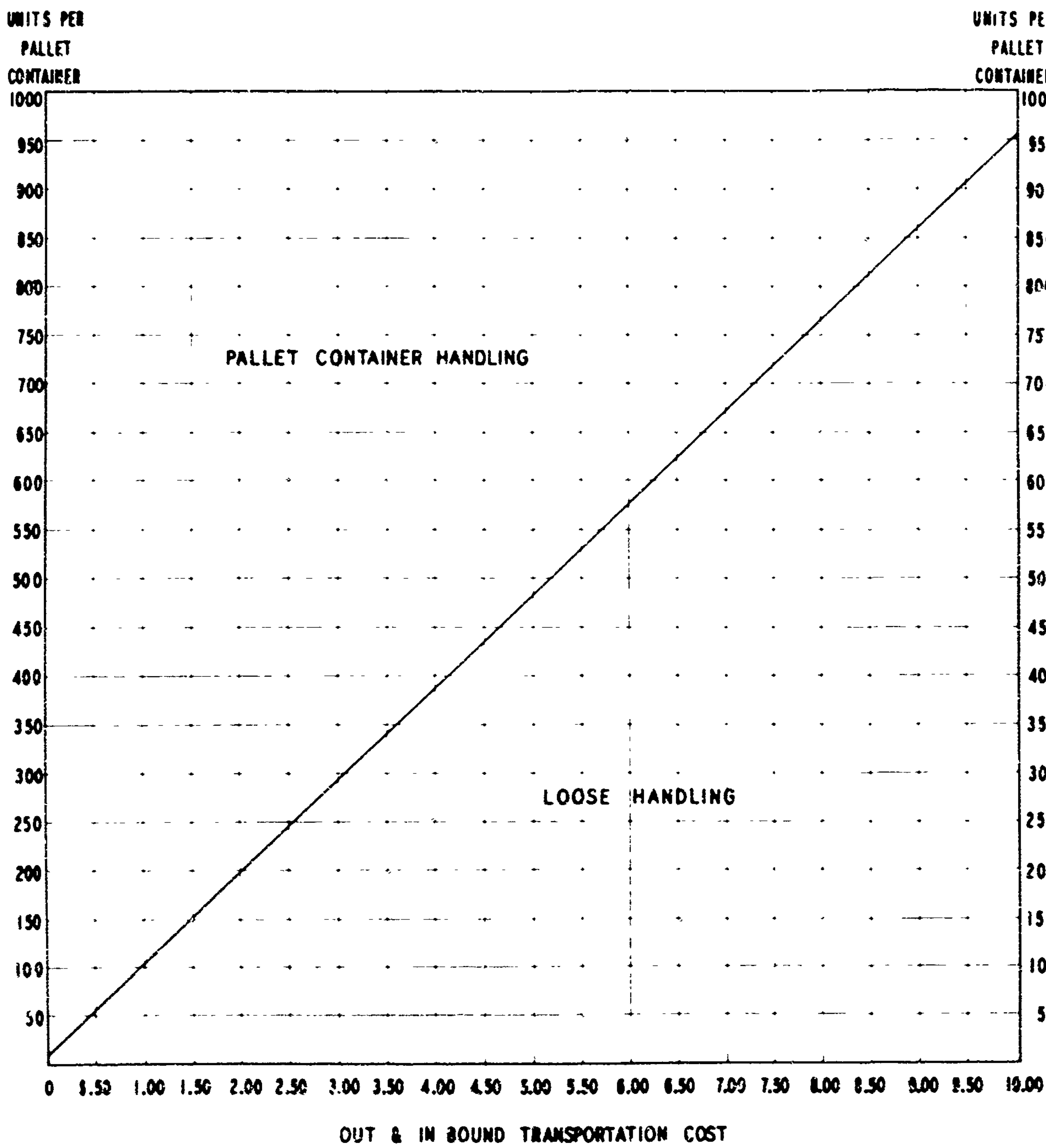
In determining whether or not this program would be practical for a number of locations, it can very easily be determined after finding out what the transportation costs are and the number of pieces per pallet container.

In some areas, rail carriers permit the return of containers at a rate equivalent to one-half of the fourth class and in others, a new rail tariff provides for free outbound transportation on the containers if an overall established material weight minimum is met. This extends the distance to which material can be shipped in pallets economically. In our dealings with transportation companies, it is advantageous to point out to them the rapidity with which trucks or cars can be loaded and unloaded thus releasing the equipment in much less time than is required if the material were shipped loose.

In addition to the handling of loose items in pallet containers, we re-examined the economics of handling master pack items as a pallet container pack. This eliminates not

Figure 22

ECONOMIC DIVIDING LINE LOOSE HANDLING VS. PALLET CONTAINER HANDLING



only the cost of the master container but additional manual operations.

The removing of unit containers from conveyor and placing them in the pallet container is comparable to the placing of the unit containers in the master carton. In our master pack operation, we seal the master containers, place them on pallets and strap the master containers on the pallet for loading in the box car. These three operations and eliminated and not performed when using pallet containers. The loading in the box car and unloading would be reasonably comparable with both methods. However, in many of our master pack pallet loads, it would not be practical to double deck. In the master pack method, the straps must be cut before removing and placing the master containers in the storage bin. Then, we have the problem of disposing of the strap and the disposable pallet and later the problem of disposing of the master cartons as they are emptied when stock is picked.

In the pallet container program, the pallet containers can be removed from the box car and placed directly in storage, as the pallet container then becomes the bin and you have substituted fork truck handling for manual handling in placing the materials in position for picking. The picking of the individual unit containers from storage is practically the same with the exception that on the master pack method, from time to time, the parts picker must open the master pack in order to obtain the individual unit containers.

In going to our pallet container pack program, we have eliminated the master packing of a number of items wherein we have saved, not only materials handling, but also the cost of the carton. Even in those instances where dealers might order in the quantity of the master pack, we are further ahead to handle these parts under the pallet container pack program because of the prior savings in materials handling.

Again, we have developed a graph of the economics of master container handling versus pallet container handling against which current and proposed master packs can be checked to determine whether the master pack method of handling is economically more sound than the newer pallet container method.

As with previous graph, all of the steps in the two handling methods were listed and costs developed through the

ECONOMICS OF MASTER CONTAINER HANDLING VS. PALLET CONTAINER HANDLING

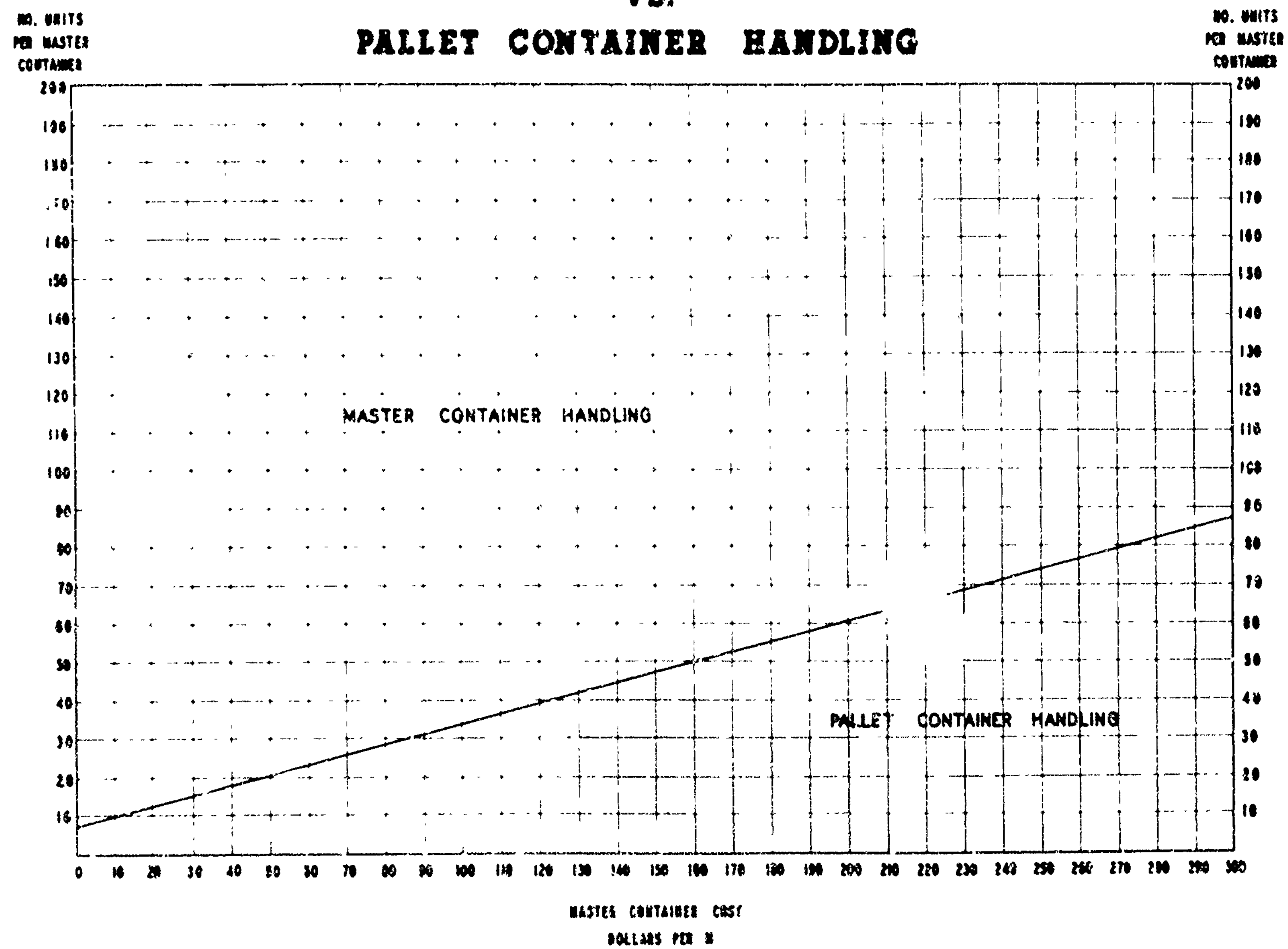


Figure 23

use of standard data we had established. The costs for both methods were totaled, and under certain conditions considerable difference was found in the two totals. Through the establishment of an equation, we found a straight relationship existing between the amount of material handled and the carton cost.

You will recall that we found the same relationship when comparing master pack handling with loose or individual handling. By changing the values of these two factors, several points were plotted on a graph and connected with a straight line. This line in effect represents the economic dividing line between the two methods of handling.

To use the graph, one merely applies the value of the variable factors and plots the resulting intersection point. If the point falls below the line, the item should be handled in a pallet container, and if it falls above, the master pack method of handling would be more economical.

From this, you can readily see that the larger items in master packs are the items that are readily adaptable to pallet container handling as these would fall below the plotted line. With many smaller unit containers in a master pack, it would indicate that the part should continue as a master pack.

This graph was developed and takes into consideration the handling at the major supply depot location and does not include the transportation factors that were considered in the previous graph on shipments from suppliers to the major supply depots.

When exploring the economics of master packs on expendable pallets versus the pallet container pack, it was found that more factors had to be considered and that a scientific method was required to readily determine when an item should be shipped in a master container on an expendable pallet and when it should be removed from its master pack and shipped in a pallet container.

Because of these added factors a graph of the economics of master pack on expendable pallets versus pallet container pack, is more complicated as the conditions for each carton cost must be plotted.

Through use of equations as previously explained, we found a straight line relationship between the number of master packs per expendable pallet, the master carton cost,

Figure 24

PALLET CONTAINER

LOADING ARRANGEMENT SPECIFICATION

PART NO. 609735

PART NAME KNUCKLE

USE. CODE Z

SOURCE CHEVROLET, GEAR & AXLE

PALLET QUANTITY 82

UNIT CONTAINER DETAIL

TYPE CBX

UNIT QTY. 1

SIZE I.D. 7 1/8 x 4 1/2 x 10 5/8

UNIT WT. 9.17

SIZE O.D. 7 1/4 x 4 5/8 x 11 1/4

PALLET LOAD DETAIL

NO. UNITS 82 LOAD WT. 752

PALLET WT. 144

TOTAL WT. 896

PRIMARY LOADING ARRANGEMENT:

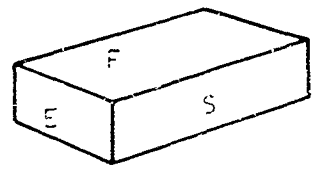
NO. UNITS ACROSS FRONT 4

NO. UNITS ACROSS SIDE 8

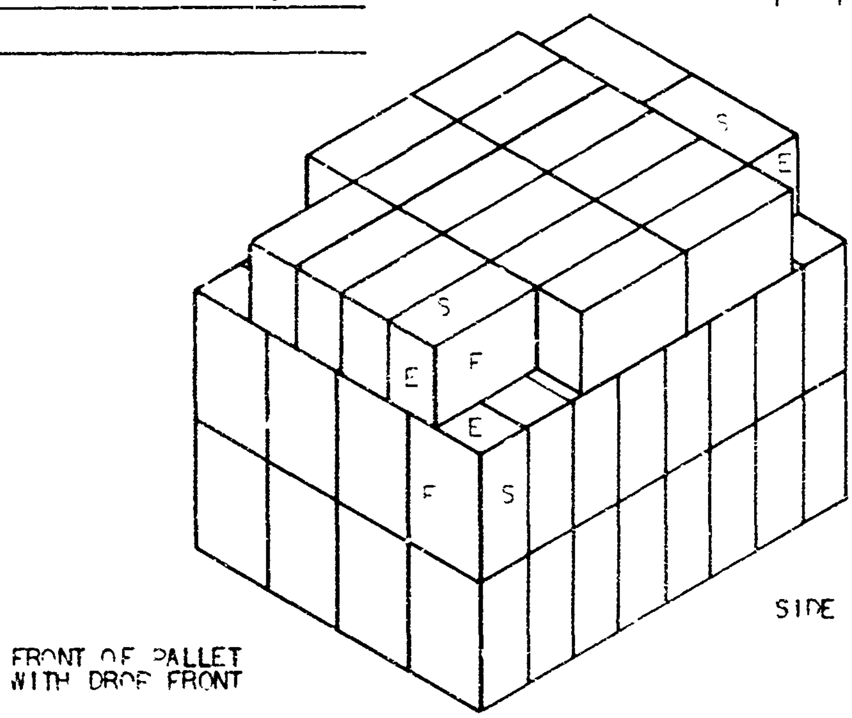
NO. LAYERS OF UNITS 2

SPECIAL LOADING INSTRUCTION:

LOAD 18 CARTONS AS TOP LAYER IN PATTERN AS SHOWN.



E - END PANEL OF CARTON
S - SIDE PANEL OF CARTON
F - FACE PANEL OF CARTON



LOAD CARTONS TO CORRESPOND WITH LETTER DESIGNATIONS - E, F AND S.

and the net transportation cost, which is the out and inbound cost of the pallet container less the transportation cost of the expendable pallet. A straight line was plotted on the chart for each of several master carton costs.

To use the chart, the number of master packs required to contain a given amount of material equal to that which could be held in a single pallet container is determined along with the net transpoı ·ation cost. The resulting point of intersection may then be plotted on the chart. If the point falls above the appropriate carton cost line, the item should be handled in a pallet container without being master packed, and if below the line, the item should be retained in the master pack on the pallet.

To use these pallet containers to the best advantage, our Packing and Research Department experimented with a pallet container and the items to be packed in the container, to develop the best loading arrangement so that the maximum number could be placed in the pallet container.

When the ideal loading arrangement was developed, the data was recorded on the pallet container loading arrangement specification sheet which showed part number and name, warehouse classification, the source, and the quantity per pallet. Details of the unit container were included, as well as details of the pallet load. A sketch was made on each sheet to show the primary loading arrangment and any special loading instructions were so noted.

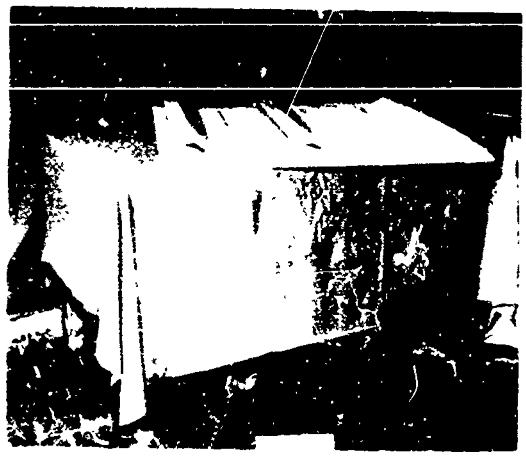
If the cartons projected above the top edge of the container, the corners were left open so that the containers could be stacked one on the other without damaging the cartons.

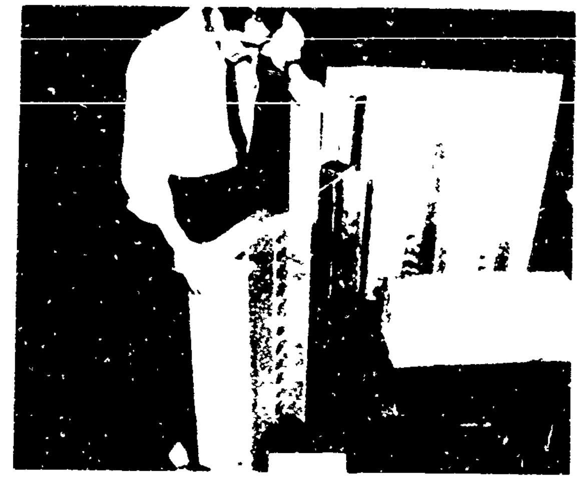
This specification sheet is forwarded to the supplier in as many copies as they may require and a copy is sent to our Receiving Department and copies are retained in the Packaging and Research Department. The use of this loading specification sheet assures uniform loading by the supplier.

Up to this point, all descriptions have been confined to pallet containers fabricated of wood or metal and our research was principally centered upon these materials for basic construction purposes.

Other materials were not ignored, however, and our latest accepted pallet and shipping container is composed of corrugated paper board with simple staple fastenings.

This container is strong, light in weight and readily stored knocked down and easily s· up for use.





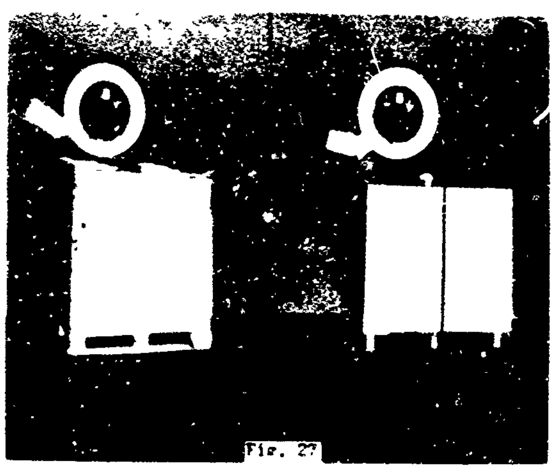
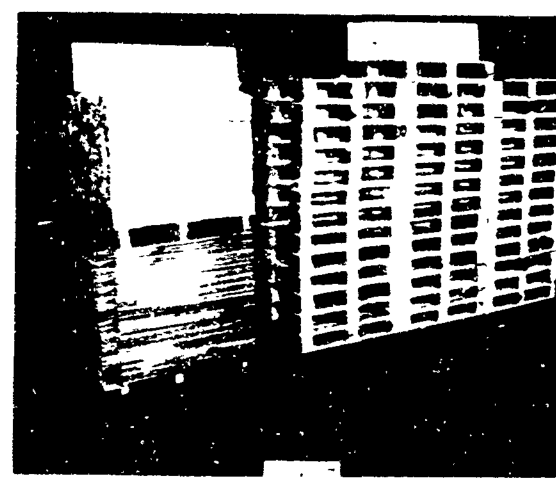


Fig. 27



There are three components, namely, the base, box section and cover which are assembled to make the finished container.

Here is how it works -

There is the knocked down base section which is delivered with end flaps flat and the leg pockets pre-stapled in the proper position.

The end flaps are first formed and stapled, to make a shallow tray and the leg stiffeners are inserted into the pockets and secured against creeping by means of staples. These leg stiffeners are simple strips of corrugated paper board glued together.

The corrugated paper board shipping container is completed by placing of the container and top sections on the pallet base. Final closure is effected by application of a single band of ordinary steel strapping which adequately holds all components firmly together. Patent has been applied for.

I am proud to state that this container was awarded first prize in its class at the Industrial Packaging and Materials Handling Exposition held at New York from September 20th to 22nd of this year.

In the past few years, we have become increasingly aware of air transport as a medium of fast and efficient movement of material from one city to another. The tare weight of conventional wood or steel pallets and containers practically prohibits their use for air cargo shipments.

This corrugated paper board shipping container is particularly suitable for air shipment as it incorporates minimum weight with adequate strength and ultimate disposal is simple and economical. Added rigidity and resistance to moisture may also be obtained by using "V" or "W" board wet strength corrugated or by dipping in parrafin.

A saving in weight of 48 pounds over the wirebound pallet box is not the only factor, as the corrugated paper board bases occupy only a fraction of valuable storage space in comparison to those of wood construction. For those who are statistically minded, the space saving is 71%.

Earlier in this presentation, I discussed portable tiering racks with usage primarily confined to raw sheet metal and items considered difficult to handle.

Tiering racks are also perfectly suited for storage of a

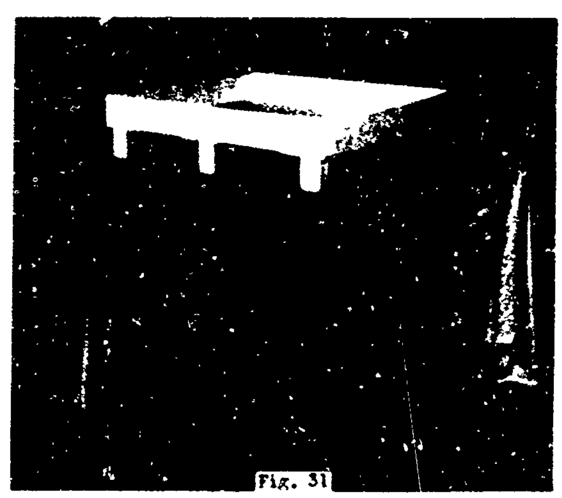


Fig. 31

large group of material that is too bulky or heavy for bin or pallet container application. The tiering racks also offer a high degree of flexibility directly comparable to the smaller pallet containers.

The riding type straddle truck which we use to handle the tiering racks, incidentally, differs from the retractable fork trucks previously mentioned insofar as width of wheel framing for added stability in handling the wider racks. The forks are not retractable.

The riding type straddle truck will operate in a nine foot aisle, while the conventional truck needs about one foot more in comparison to the approach position.

Wheels are always awkware to store in quantity, particularly in piling to any considerable height with safety.

Racks have solved this and many similar problems.

The wheels are placed in the rack as the box car is unloaded. The dolly base is used to move the rack to temporary dock placement and the fork trucks place the racks of wheels in position in the proper stock location. The bottom of the posts on the tiering rack extend to form a positive interlock with the top of the posts in the lower racks and provide a solid and safe tier.

In some instances we are confronted with problems involving parts that are not adaptable to storage in standard bins, pallet containers or racks.

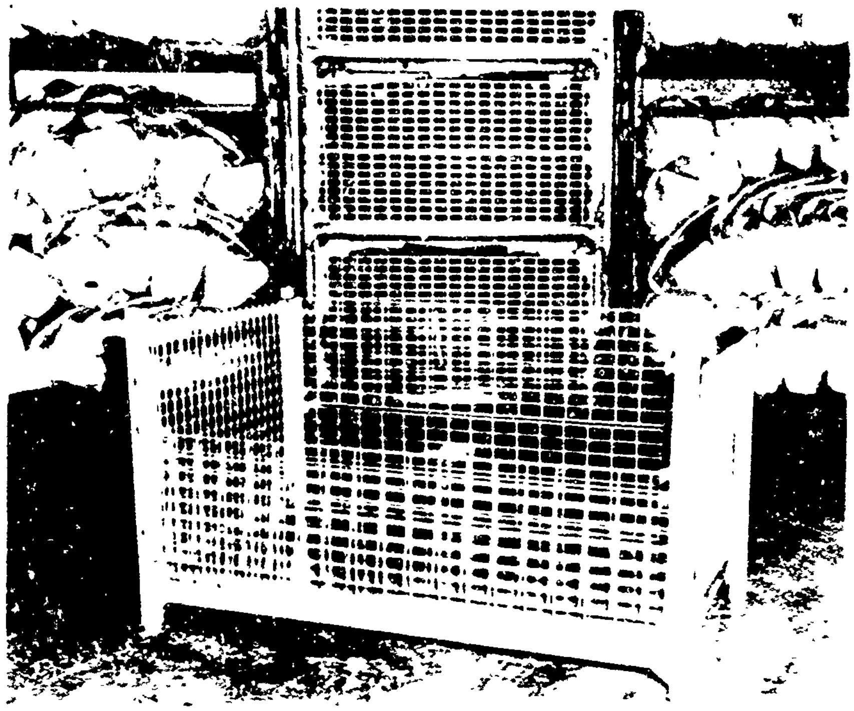
This may be occasioned by size of the part, proclivity to drift or impracticability of corrugated container usage due to cost or other factors.

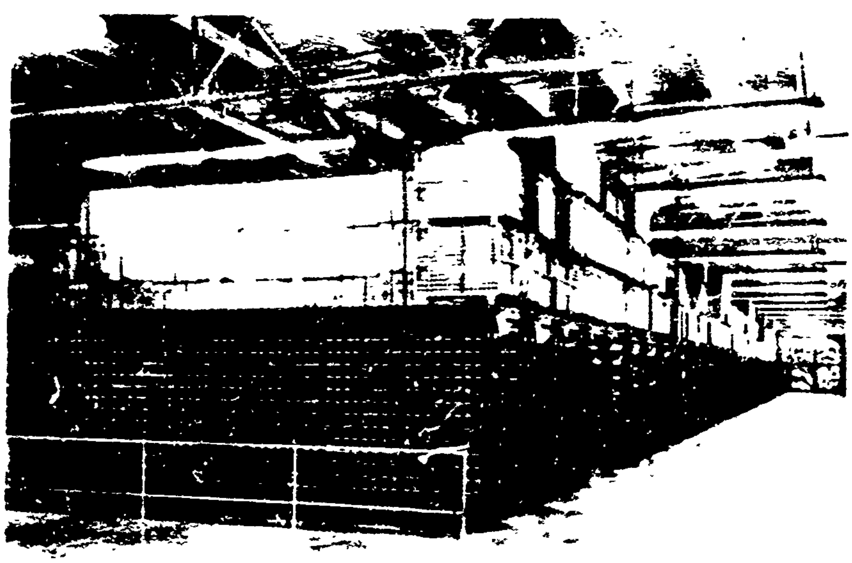
This problem was overcome by strating with a regular tiering rack section to which we added steel wire grid end fillers that clip securely to the rack top cross bars. These ends are interchangeable.

Then side grids are applied that lock into brackets on the end grids and the tiering rack in effect has become a large pallet container. The sides also are interchangeable.

In common with its smaller standard counterpart, the side was made to open to afford easy accessibility in picking stock.

The versatility of these tiering racks affords numerous





opportunities to save space in storing many other articles that previously took up disproportionate room as they did not adapt readily to stacking in economical heights.

To me, the primary purpose of a warehouse is storage. Yes, we receive, unitize, process, ship and perform other operations in the warehouse, however, the material passes through all of these operations rapidly, in many cases a matter of a few hours or days.

But - when ...rial goes to storage, it usually becomes at best a matter of days, weeks, months or even years. Considering this aspect, every effort should be made to utilize every possible cubic foot or air space for storage.

We had made sporadic efforts to store extra material on tops of bins to relieve the rack area, but this was limited to lighter, large carton stock and similar items that could be easily stored, primarily by hand, from the bin aisles.

The answer to the problem of utilizing overhead open bin aisle space was simple, so simple, in fact, that it had been consistently overlooked. Installation of steel grating over the tops of the entire bin sections provided a secure area for storage, serving in effect as another bulk floor area without the necessity of building expansion.

Palletainers stored over large bin sections are examples of full utilization of previously wasted space. All material is readily available for removal by fork trucks and the savings are obvious.

I could go on at great lengths, and some of you perhaps feel that I have, but materials handling, in a broad sense as well as the myriad "by products" involved, presents a fascinating field and the ultimate results justify the efforts involved.

The overall program is completely flexible and the pallet containers, tiering racks and fork trucks in their present stage of development and usage are adequate for current needs. However, research is a never-ending pursuit and future developments will undoubtedly supply more in the way of equipment and methods that will provide even greater efficiency in all phases of materials handling.

It has indeed been a privilege and pleasure to be with you.

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Tuesday AM Oct. 11, 1955

Materials Handling in Production

Mr. H. O. Horning
Supervisor of Materials Handling, Chrysler Corporation

As far as materials handling in production is concerned I sometimes think that production is only incidental to the materials handling. I am sure if you people went back to your operations and checked the ratio of your materials handling and storage time against your actual machining time you would find out that you are in the materials handling business too.

In a talk recently at a luncheon sponsored by the American Machine Tool Distributors Association, Bill Newberg, president of the Dodge Division, coined a new word: volumation. I have seized on to that word for I believe it well describes the area in which materials handling engineering now finds itself. Handling materials economically in large volumes through receiving, through processing and shipping is a science which to me "volumation" seems to cover.

The old one-man-per-ton unloading time is gradually disappearing and well it must. The days when all you did was throw extra manpower in to quicken a job are gone. Neither the labor rates nor the manpower availability permit you to do this economically. Suppose we were still in the piece-by-piece handling business on all material? Let's take a situation that Chrysler had at their Plymouth plant. Five million pounds of material pour into that assembly plant daily. Now, this means that those fellows have to unload 350 trucks. They have to unload 90 railroad cars each and every day and they are doing this through 25 truck wells and 50 carload unloading spaces. Certainly, unless there was some method of quickly unloading this material the whole operation would be stymied. We certainly couldn't at all conform to materials handling objectives.

I mean the objectives of materials handling engineering, those objectives to me are the handling of material from point to point in the process of manufacture and distribution so that each article will be at a place prescribed, will be there at the time needed, will be there in the quantity required and in an undamaged condition.

Materials handling engineering itself insures that the above requisites are accomplished at the lowest possible cost. Now, this does not mean that every materials handling installation is inserted at the lowest possible cost because many times we

increase our materials handling costs if we can show a savings in our over-all production costs.

It becomes quite apparent the scope of materials handling is wide, covers all stages of creation and distribution. The techniques, facilities and the equipment vary greatly in different activities. They even vary in the same activity in different plants. Each problem requires an independent study.

Later on, or in a few moments, I would like to talk about our newest and most modern facilities. We have attempted in this new plant to apply techniques that up to this time have remained untried in the materials handling field. Now, I am referring to our Plymouth engine plant which began operations in August of this year.

During the production of our 1955 model Plymouth car, demand for the V-8 engine became toogreat for our ability to produce this power plant in the existing facilities -- we just couldn't do it. Despite the fact that a new engine plant installation takes two to three years, this particular plant was set up with a target date of 14 months. We achieved that and in August of this year, just 14 months after the start of the new installation, engines began to be produced in quantities. By quantities I mean 600 a day.

The thing that we're shooting at in the engine plant is 150 engines per hour, 3,000 per day, and that goal will be reached within the next two or three months.

But, before I discuss the engine plant, I would prefer to discuss this materials handling situation very briefly on a corporation-wide basis.

Receiving still is one of our big problems but a few years ago it was a much larger problem. Much of the material was handled loose. It took us 15 to 20 hours to unload a truck. We spent all the way up to 30 and 40 hours unloading a railroad car. Those were unloading times that we just couldn't afford. We had to speed up the operation.

The only "out" for us, of course, was to go into a unitization program. By "unitization" I mean consolidating either parts or packages into a volume that could be handled mechanically. The old piece-by-piece handling we tried to eliminate. When I speak of a unitization or palletization program I am not referring to it as a complete program because we never expected to reach 100 percent in the program.

If we did reach 100 percent the cost would kill us -- I mean beyond a certain point. I would place that point somewhere at 30 to 40 percent of the receival items unitized. Beyond that point, that type of a program becomes uneconomical. You have the railroad, the freight factors, container costs -- you have all those items to consider. You only take those programs that you can justify, either find a savings in it or at least break even. You certainly don't spend money just to get a good looking package.

One of our first attempts toward unitization project was back in 1936. We attempted to unitize the lower control arms that we received from a Milwaukee vendor. I think we have opened that thing up periodically every year for a while; now we're down to every three years. We have never been able to justify either the palletization or the skid boxing of lower control arms. Freight ate our savings up and, inasmuch as any package that was economical to handle only held 90 pieces, there was quite a lot of penalty per piece. We had to give that up.

A few years ago glass was shipped to us in wirebound boxes. We got a few pieces of glass well packed with straw. What happened when we took it to the assembly line? The glass box was opened: we had 10-12 pieces of glass; but we also had two or three wheelbarrow loads of straw. The straw had to be disposed of. It was unsightly around the glass installation, a hazard and it was further a fire hazard. Smoking is allowed in most of the plants and only restricted around the glass areas, so, for that reason, we had to watch that constantly to avoid any possibility of fire.

When the glass industry was first asked to palletize these in large quantities they threw up their hands. It had been a shipping method with them for years. Breakage was low. They didn't want to try to change. A few of them were convinced that economies in handling could be had from handling large quantities, so reluctantly they entered the program. Today I think most all glass from all glass manufacturers is palletized in large units. Our breakage is declining also and our handling costs have gone down considerably.

Studies have shown us, of course, that the economy in handling is directly proportional to the size of the package. The larger the package the more economy you have in handling. Of course, you have certain limitations on the size of the package and also in weight, which you cannot accommodate in your aisle spaces and so on. So you have to draw a line someplace.

In our receiving area we make great use of skid boxes wherever we can get them economically from vendors. We get palletized shipments, skid box shipments, rack shipments. We attempted to get some type of a container that will quickly pass through our receiving dock, through our temporary storage area and on to the production line, so that the material can be used from that particular container at the first operation.

Cartons have always been a headache to us. We can't avoid them but I don't know of anything more unsuitable than to go into a plant and find great piles of both empty and full cartons kicking around a particular assembly area. Even if a materials handler does stack a neat pile, usually during the lunch periods they are rearranged by the production workers to make either a bed or a chair. The result is that you have a bad condition develop there. You have internal damage that you get after you have safely transported the package to the first operation.

With this attempt to increase the size of packages to handle more mechanically this material that we get loose at our receiving docks, we at that point either containerize it in skid boxes or racks or on a pallet to handle it through the balance of our operations mechanically, but through this our safety department tells us during the past few years we have also had a reduction in some of our hernia cases. They have always plagued automobile companies, where they tugged around with these 70-80 pound packages. Mechanically handled, much of this labor fatigue is being reduced.

We use racks in our operations, racks in which we attempt to standardize on the size. That is for the transfer of material from plant to plant or within the operation itself. Some of our standard sizes, for example, are 48-84, 40-108 and 40-48. I certainly won't attempt to tell you why we picked those sizes. They were working and work well for us.

The rack I am referring to is a tubular steel rack. As you noticed in Mr. Pearce's presentation a few moments ago, he showed you pictures of wire-meshing the racks. We also do that. It makesthe rack very flexible. Then it can either be the rack or skid box. All his pictures showed the 2x2 mesh. We are getting, for the sake of economy, the 2x4 mesh which is working out well.

Outside of our universal racks, of course, we have a great many racks that are fairly highly specialized. By specialized I mean racks that will only contain the part for

which it was intended. One thing that has brought this on are some favorable freight rates that have come forth in the last several months. The railroad companies have now said if you produce a rack for a container of a highly specialized type -- I mean some of the railroad companies have said this -- of a highly specialized type, you weigh the rack, ship it in our cars and we will give you freight-free both going and return on your rack -- but it must be highly specialized. That has changed our whole concept on handling of sheet metal parts to distant locations. It has forced us to go into a specialized rack program. Of course, we were always in the specialized rack program somewhat because we handled engines, differentials and such assemblies as that on racks and have for years. They were highly specialized.

Skid boxes, especially the wire mesh boxes, usually manufactured under a couple of patented names, have opened quite a field for us. Its collapsible features have given us some very favorable return freight rates and we have been able to insert this into casting, forging and heavy parts shipping from rather distant points, especially when our handling warranted it. We're using that particular type of container more and more. It does another thing for us. We have to use the air rights in our plants. Space is precious and at a premium and we stack to a height of 15 feet. Some of our safety engineers frown on it but so far they haven't stopped us from doing it. We can put the wire mesh containers 15 feet in the air and practically inventory our material from the floor. At least, we can tell what is in it and approximately how much. In the old steel skid boxes this was impossible.

Well, I want to quickly go on now to our new engine plant. As I mentioned before, we tried to employ all the short cuts and all the modern handling techniques we could possibly put into one operation.

Before I go on, may I make one more comment? I told you how well racks, pallets and these large unitized shipments have helped us. It has some disadvantages too. Some of the things we don't like about it: The fact, regardless of what type of container you put in your operations, the thing must be removed when empty, so you have another operation and that is the handling of the empty container.

We have one plant in the Detroit area and in running a cost on the disposing of expendable pallets our cost is running about 14¢. We have set aside special areas in other plants where we collect, segregate and prepare returnable containers for return to the vendor. It costs us money. So, many of the

savings we have been able to pick up at our receiving dock we have dissipated through our returnable container area. We're watching it closely. It is not getting out of hand. We still think we have enough intangible savings in many of our operations to continue the unitized method of receiving and processing material through our operations.

Now let me jump to that engine plant, which is a sprawling, one-story building, consisting of slightly more than 600,000 square feet. In this particular plant we have a receiving area on one side at the end for trucks. The balance of that side is used up for railroad cars. We're somewhat cramped with our receiving space. Our truck well, which has a temporary storage area behind it and also a receiving inspection area, only contains nine truck wells. Our railroad dock contains 14 cars. There are two tracks side by side, seven cars on each track. Due to these restricted receiving facilities -- and you perhaps wonder why we didn't provide for them. The reason is that we use the Bissing plant. That is one that was built only a few years ago but we use that rather than attempt to build a new facility for this and we were just not able to get more receiving area. The result is that we have tried and we are progressing very well towards a 100 percent unitized receiving dock in both railroad cars and in our truck wells. We have to in order to rotate these cars. (3,000 engines per day, 500 blocks in a railroad car.) There are quite a few carloads of blocks that must be unloaded over those 14 dock spaces. We have to have them palletized and we're getting them palletized 20 blocks to a pallet, so we can go in there mechanically and pick them up.

We do provide, however, for temporary storage adjacent to all the receiving areas. We get no back-tracking. It is a free flow. As we receive out of these transportation vehicles, we set it into temporary storage where it goes through receiving inspection and then moves across an aisle and starts its way into the operation.

All of our operations move across the plant to one side. At that side of the plant a 565 foot engine assembly line winds its way toward the front of the plant. At the front of the plant we again have our shipping area. We have no back-tracking of materials whatsoever. As far as possible, that straight line flows through this plant.

We take a block, a pallet of blocks; we set it on the block line. Now, from the point that we receive that pallet load of blocks our block line starts within 25 feet. We set

it on the block line that starts through a broach and starts down a working height indexing conveyor through a machining operation. That block is never touched again through all its machining cycles and when we get it it is a perfectly rough block that winds back and forth through the plant in order to completely enter and be discharged from the various machining operations that are necessary on it. It crosses an aisle overhead rather uniquely. I won't attempt to describe it. And it eventually comes back to the beginning of the 565-foot assembly conveyor untouched. It is never again manually touched.

In practically all our operations where we insert the raw material into the operation it goes to the assembly line with little or no handling whatsoever. We have 25 conveyors in our monorail system. We have 17,000 lineal feet of conveyors in this system. It delivers all finished parts to the proper assembly station on the assembly line.

Now, rather a unique operation -- I think it is worth mentioning -- is our small parts. Bolts, nuts, washers, small gaskets, etc., have always been hard to handle. They have been messy. The planning department likes to carry a 15-20-day bank. The materials handling department wanted to put them all at the assembly operation. The result is that you people who have been in many of these plants find spillage around those particular areas to the point where the floor is literally paved with them.

In our new engine plant we decided to send all the finished parts from a remote area to the assembly line. We took bolts, nuts and screws and set up two banks of automatic counting machines. I said two but there are three banks, three double lines of automatic counting machines, hopper filled. The hoppers are filled with the bolts, nuts and small parts that go to make up the motor assembly. Between these hoppers there runs a slack conveyor. On this slack conveyor travels a plastic tray. The various trays travel down through the banks. One tray, I think, has twelve compartments and the other one, the largest one, has 16 compartments. That stops automatically at each one of these counting machines, where the proper number of bolts, washers or gaskets are counted into the tray and placed into the compartment designated for those parts.

At one of our lines the tray makes 17 stops. At the 17th stop we manually put in two large pieces that we haven't devised a hopper for yet; but it travels to the end of this slack conveyor and there is a man to take a visual look at it, see it is filled. He sets it on the overhead conveyor and there it

is transported to the beginning of the engine assembly line, where it is removed at that point and set on a floor pedestal. Our engines are assembled on floor pedestals indexing down the assembly line.

The three trays come to that point with all the component parts to assemble an engine. As the workman needs it, he uses the part out of these trays. In this particular operation he needs six bolts and there are six bolts there and that is all there is there, six bolts. You supply it to him in the proper number and we supply it to him at the proper time.

The three trays are color-coated so that it will designate certain parts and the workman knows which tray his particular part is in, the red tray, green tray or brown tray.

As the trays are finally depleted of these small parts they are removed from the engine assembly line, set on the overhead conveyor and go back and start their trip again.

All our other parts, such as water pumps and the various component parts that go to make up an engine are delivered, as I mentioned before, by overhead conveyors directly to the point of assembly. Chain case covers, crank shafts, cam shafts, manifolds -- all are delivered by overhead conveyors.

Now, at the completion of the assembly line this engine is picked up automatically from the floor-type pedestal assembly conveyor by an overhead conveyor and there it is taken to the engine test area. Now, at the engine test area, we inserted a manual operation. A man removes from the overhead conveyor this engine and sets it on a platform traveling on a roller conveyor. There are two platforms on this conveyor. One is designated an A-platform and the other a B-platform.

He sets it on the A-platform because it is a cold motor. There it travels down through a bank of testing machines. We have three such banks. Each bank is comprised of 24 testing machines. Whenever that cold motor gets to a testing machine that is empty it automatically diverts itself into that particular testing machines. As soon as it is properly positioned in the testing machine, theoil connections, the gas connections, the water connections and the gas fume connections are all made automatically. No one is around there and the engine is started.

8 of 10

If there is a failure it immediately stops and a light on a control board tells you what failed. If there is no failure and it is functioning properly, it runs through a cycle of ten minutes. At the end of 15 minutes a light comes on the board. Two men operating the engine test stands take a look at this light. They travel down or walk down, make a few minor adjustments in gas mixture or in valve mix clearances, and at the end of 20 minutes the motor automatically shuts off and the first B-stand that comes by empty, it goes out on to the B-stand, and moves away from the engine test area.

From there it moves to the end of the testing conveyor where we again pick it up manually and put it on an overhead conveyor. From the overhead conveyor it travels to our engine loading area.

Now, I want to comment briefly on this engine loading area. We had some pretty hot discussions on how automatically we wanted to go into this particular area. There was some thinking that we wanted to load our racks automatically. There was other thinking that we didn't. We decided not to and I won't go into details as to why we decided not to, but it is obvious if anything happened there it would slow the whole thing up.

These motors are being produced one every 20 seconds and certainly must be taken off of the line and disposed of in some manner, so we placed them into the largest motor rack in existence now, 84x84. It is a huge thing and holds six engines.

The novel arrangment at this point is that the motor rack on each of two sides has two lugs projecting. If it is an out-of-town shipment of motors, a man with a fork truck picks it up and takes it into a railroad car. In the railroad car are rub rails. The rub rails are notched. As he lifts the rack above the rub rails, takes it into the end of the car and deposits the rack. The lugs on the edges and on the ends of the rack and engage into the slots on the rub rails. He puts in 21 racks, each rack containing six engines. He stacks them three high. One man does this operation in 41 minutes and when he backs out you shut the car door. Every rack is anchored in place; every rack is blocked; every rack is braced. There are no more crossbars to work into place, no lumber blocking, no blocking of any description. Each rack is individually blocked.

Our shipments to the coast go through as if you carried them out there in your car.

I think our chip handling in this new plant is beyond all imagination. It has alwaysbeen a headache to a materials handling engineer. The disposal of chips, the disposal of scraps -- we have solved it there and I just haven't time to go into it.

The comments I made here briefly touch on some of the modern methods that are now employed in production. In manufacturing for today's market production must be more streamlined than it has ever been before. Chrysler is continually devoting study and attention to reducing cost and time necessary to turn out its products to meet consumer demands.

Volumation is a necessary word in manufacturing because it is characteristic of consumption and distribution in this day and materials handling must and is playing its part in this volumation process.

Tuesday AM Oct. 11, 1955

Industrial Counterparts of Military Packaging

Mr. John Mount
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Packaging for industry, to a degree, is very similar to packaging for the Military. I inserted "to a degree" purposely and let me explain why. Webster defines "degree" as a derivative from the Latin "degradare", meaning to degrade, to reduce from a higher to a lower grade. Degree can also mean relative quantity or intensity. Thus packaging for industry as compared to the military, is a reduction from a higher to a lower grade and it is relatively somewhat less in quantity or intensity, particularly for overseas shipments.

When we speak of relativity we immediately think of the late Dr. Einstein and his formula. Perhaps we in the packaging field need an Einstein and a formula. As I sit at my desk in Philadelphia, and am confronted with packaging problems, I often wish such a formula existed, so that I could put the unknowns in their proper place, turn the crank, and come up with the right answer. But unfortunately no such panacea has ever been developed.

While no formula exists, there are certain rules or guides that do help us in determining what packaging is necessary. These rules or guides are not consolidated into one or two engineering handbooks. Instead they are spread out over many publications and they are not always easy to find, and when found, are apt to be rather general in nature.

Right here I would like to state that they deal primarily with domestic shipments. There are no rules or regulations for industrial (or commercial) export or overseas shipments. There are reasons why this is so and I will cover that phase in the latter part of my discourse.

As I just mentioned, there are rules that guide us in packaging our industrial domestic shipments. In general these rules and regulations are also followed by the military in preparing their domestic shipments. Undoubtedly the best known and most used is the Consolidated Freight Classification. Included in this voluminous document are certain basic rules.

For example Rule 5 says "Articles tendered for transportation will be refused for shipment unless in such condition and so prepared for shipment as to render the transportation thereof reasonably safe and practicable."

Rule 6 covers the marking of freight while Rule 21 relates to nested articles. Rule 40 specifies the requirements for such containers as boxes, other than fibreboard; crates; pails, barrels and drums; single trip metal barrels, drums, kits or pails; paper and textile bags and so on.

Rule 41 covers the requirements for all the fibreboard containers, such as corrugated and solid fibreboard boxes, the fibreboard drum and pail, the cleated fibreboard box etc. This rule goes into considerable detail with regards to the bursting strength of the fibreboard for certain weight and size limitations, to the type of manufacturer's joint used, to the methods of sealing, and many other factors in the make up of the containers, too lengthy to discuss here.

Similar to the Consolidated Freight Classification in so far as packaging requirements are concerned, is the Official Express Classification published by the Railway Express Agency. Still another similar document is the National Motor Freight Classification, except that in some instances it is more lenient.

Undoubtedly one of the most comprehensive and exacting regulation for domestic packaging is the Interstate Commerce Commission Regulations for "Transportation of Explosives and Other Dangerous Articles by Freight." It is frequently referred to as the "ICC Red Book." This regulation goes into great detail and specifies the types of container that can be used for each explosive and dangerous article itemized, the descriptive labels that must be used on the shipping container, as well as the permissible quantities therein. Failure to use this regulation properly not only endangers the safe delivery of the contents of the container, but also the safety of all other cargo in the shipment as well as the personnel who have to handle it.

The Association of American Railroads also issues a special tariff entitled "Specifications of Standard Containers and Loading Rules for Fruits and Vegetables, Fresh and Green (not Cold Packed nor Frozen)." The rules in this tariff apply to shipments of fresh fruits or vegetables and supersede the rules in the Consolidated Freight Classification. Certain other commodities are also covered in loading rules and recommended methods of packing as published by the Container Section of the Association of American Railroads. These appear generally as pamphlets and manuals and serve as a guide rather than as a regulation.

The Federal Government, of course being a prolific publisher, also gets into the act in a rather lengthy series of

federal specifications which cover the very large number of "civilian-type" items purchased by the Government. Included in these specifications are the packaging requirements. Of course many of these specifications are for the containers or the materials themselves. Incidentally these specifications are easily recognized by the uniform method of designating them. For example, "PPP-D-729, DRUMS: METAL, 55 gallon (for shipment of noncorrosive materials) is typical. Generally they define the commercial materials normally supplied and used and of course agree with the various rules and regulations previously referred to.

Another Government Bureau, the Bureau of Standards, offers a special service to industrial groups by which simplified practice recommendations may be prepared and issued. They are of course on a voluntary basis but do serve as basic reference material. Perhaps the best known ones are Simplified Practice Recommendation R-247-52 "Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipments" and R-146-41 "Corrugated and Solid Fibre Boxes for Canned Fruits and Vegetables."

You will notice that no previous reference has been made to any rule or regulation in so far as air cargo is concerned. Of course air freight is the youngster in the transportation field. The air carriers as a group have done very little as yet on packaging. Individually, some of the carriers have concentrated their packaging efforts in such a varied field as fresh fruits and vegetables, lobsters, honeybees, ladies dresses, horses, etc. Actually, in many instances the action has been toward eliminating packaging and concentrating on the materials handling; particularly, when no land transportation of any length is involved, before or after the air movement.

The only reference to packaging by the air carriers is contained in the Official Air Freight Rules Tariff, which states "Any articles susceptible to damage as the result of any condition which may be encountered in air transportation, such as high or low temperatures, high or low atmospheric pressures, or sudden changes in either, must be adequately protected by proper packing and any other necessary measures." A rather general statement and certainly vague as to information as to how to pack.

I believe that covers some of the most important rules and regulations. In addition to these, there are of course, many handbooks and similar publications prepared by the Trade Associations of the Manufacturers of the containers. To mention a few, there is "The Handbook of Corrugated and Solid

Fibreboard Boxes and Products" prepared by the Fibre Box Association, "General Manual No. 3" prepared by the Paper Shipping Sack Manufacturers Association, "The Wooden Barrel Manual" prepared by the Associated Cooperage Industries of America.

I mentioned earlier that there were no rules or regulations for industrial or commercial export or overseas shipments. This has been a recognized fact for a number of years and of which much can be said both pro and con. As a matter of fact a mass meeting was held on the floor of the Maritime Exchange in New York City in 1949 for the purpose of discussing the annual loss of many millions of dollars on shipments made by American Foreign Trade Interests in which loss and/or damage was allegedly caused by improper or inadequate packing.

One of the subjects discussed was whether or not a mandatory "code" of minimum packaging standards should or should not be adopted. Such standards would be similar to those used by the Military in their various JAN'S AND MIL Standards.

As a result of this meeting, a temporary committee was formed of various representatives from steamship companies, shippers, marine underwriters, and other groups directly interested in foreign trade. An independent consultant packing engineer was called upon to render technical assistance and a rather complete survey was made.

The following is quoted from part of the committee's report:

> "The tests conducted by the Committee's Packaging Engineer and the examinations made at discharge ports of the "suspect" shipments established beyond question of doubt that there is need in many quarters for better attention to the packaging of cargo intended for shipment in overseas trade. It is also apparent, though to a lesser degree, that the carriers of cargo overseas might well give closer attention to the care of cargo delivered into their custody, its stowage and the type of gear used in the loading and discharging operations.
>
> "It is the belief of the Committee that the cure insofar as packaging is concerned does not lie in the promulgation of minimum requirements for packaging nor the creation of a Bureau designed to supervise or control packaging, nor is it considered advisable that there be intervention on the part of

Government in the form of the issue of a Code."

The committee recommended that the Maritime Association of the Port of New York appoint and maintain a permanent Packaging Committee with revolving membership. The committee should include at least one outstanding Packaging Engineer to serve as a consultant. The membership should be made up of at least two representatives of shippers, two from the carriers and two from the underwriters.

Thus to date no code has been suggested nor do I personally believe any ever will be, either by this committee or any other representative organization.

My reasons for making this statement are based on the following problems that would have to be either answered or overcome:

1. The varied number of carriers involved in overseas transportation. Some of these carriers operate under the U. S. flag but unfortunately the majority do not. Even if both these groups could be coordinated we still have the so-called "tramp" steamer whose agents or operators could never be brought into any agreement.

2. The difficulty in establishing minimum standards which would be economically just to all shippers. Obviously a shipper to some nearby port in Puerto Rico or even Continental Europe would require lower standards than the same commodity shipped to ports in Iran or Indonesia.

3. The problem of Customs Regulations particularly to those countries where the duties are assessed on a gross weight basis.

4. The competition of foreign manufacturers and shippers, whose labor costs are less than ours. As the buyer pays the packing costs, the foreign manufacturer or shipper has an advantage if our packing costs are too great in proportion to the value of the goods shipped.

5. The economic problem as to whether or not it is better for either consignee or shipper to absorb a certain amount of loss and damage rather than pay for the excessive packing costs that may be involved to prevent loss and damage to a so-called cheap item. To protect adequately

the so-called cheap item might cost more than the item itself is worth and therefore a certain amount of loss and damage can be economically absorbed by shipper and buyer.

6. The length of the trip involved. By that I mean whether the item is manufactured in a seaport and shipped to a foreign seaport where it is used, or whether the item is manufactured at some inland point shipped to the port of embarkation for overseas shipment, and then a further inland movement from the port of debarkation to the final place of use.

7. Finally, the problem of policing a code or series of standards both in this country and abroad.

Through the usual cooperation for which American Industry is renowned, many of the aforementioned problems have been solved. If the shipper, and most of them do, obtains the cooperation not only of other similar industrial representatives, but also of the carriers and the underwriters, a pool of experience can be continuously tapped. After all sound delivery is proven by performance and experience is something we cannot pass along by any minimum of packing standards.

Let me illustrate this point by a couple of examples. Several years ago we were involved in the insurance of some second hand textile making machinery moving from this country to South America. I personally visited the mill in the Carolinas where the machinery was being packed. The protection against corrosion was obviously inadequate and recommendations were made for cleaning the metal parts involved and for proper protection using rust inhibitors and moisture proof linings. Admittedly these recommendations would increase the costs of packing these machines considerably.

The shipper refused to agree to these changes and the underwriter's only recourse was to refuse to insure against rust damage. So much of a controversy developed, that we decided to check the outturn. Of course I wouldn't have used this example if we hadn't been right. A considerable amount of rust damage resulted which could have been avoided by the shipper spending approximately another $1,000 or so in a shipment valued at several hundred thousand of dollars.

Now let me give you a counterpart. Not many months ago we were again insuring a large shipment of second hand machinery. This time the value was well over a million dollars

and we were also involved in any consequential loss, should any piece be damaged and not usable. We were liable for the loss of time involved until the damaged piece could be rebuilt or replaced.

Loss prevention was deeply involved and before a nail was driven or a part greased, we met with the head of the shipper's packing department as well as the head of the firm doing the packing. I must give credit for a fine preliminary survey by the shipper's packing man. The three of us went over this, made some changes here and there, and finally the job started, but not before the carrier's representative was also called in because of railroad clearances and hold sizes.

Because of the values involved and the consequential loss potential, we watched that packing job closely and also had our representative supervise loading and unloading procedures. In spite of all this, two cases were mishandled and dropped, but the loss will run only a little over $1,000 or about 1/10 of one percent.

A problem that all of us in the packaging field are confronted with, is the cost of packing. On domestic shipments invariably this is included in the price of the article shipped. On exports, however, the shipper is more prone to show in his invoice not only the charge for the item but also certain extra charges such as insurance and freight if sold as a C I F (cost-insurance-freight) basis. Frequently the invoice will also bear a packing cost, because the shipper is put to additional expense over and beyond the domestic packing cost.

A recent poll conducted by a leading exporter's magazine, The Export Trade & Shipper, brought to light some interesting information. Of all shippers answering the poll, 69 percent said they make an extra charge for export packing. While approximately 10 percent charge extra they include the charge in the export price quoted. Another group of about 14 percent use their domestic packing for export while only 6 percent absorbed the charge themselves.

Another interesting development was that approximately 75 percent, or three quarters of those who charge for export do so at their cost figures. Of the balance, the majority based their charge on a percentage of the value, and 5% of the value, was the average charge.

An example of good old American know-how as well as cooperation of all concerned, is the present trend towards unitizing or palletizing of shipments. We find this trend

not only in domestic shipments but in overseas shipments although I must admit that for the present there is much more activity in the domestic field. In some cases this means unitizing or palletizing a group of small packages. In other instances, it means the loading of an entire motor truck trailer, "piggy-back" fashion on a railroad flat car and moving the latter by rail from say New York to Chicago. Similar movement has also been used successfully from East Coast Ports to Puerto Rico and from West Coast Continental Ports in the United States to Alaska. Export shipments have also moved in vans or cargo containers which are packed with many small packages, usually in domestic packing, and delivered overseas successfully and safely. As more and more materials handling equipment is available overseas such type of movement will increase. As an extreme we even have coastwise movement of entire railroad cars by vessel. This is one counterpart that so far, to my knowledge, has not been duplicated by the Military.

In summing up, the industrial counterpart of packaging has many of the same aims that the military has. We must protect the product, we must provide all around economy, we must have a simplified packaging operation which offers minimum handling resistance and it must be suitable for good warehousing either by shipper or consignee. Here we in industry have an advantage because warehousing at destination can generally be expected to be better than that offered by the military particularly when the latter are in combat. We can therefore more easily meet the definition of an ideal shipping container which someone has so aptly defined as "costs nothing, delivers the goods anywhere in perfect condition, and then promptly disintegrates."

Tuesday PM Oct. 11, 1955

A Dynamic Cushion Tester - Its Application To Cushion Design

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The ever-increasing complexity of missile and aircraft functions has resulted in the development of extremely precise and delicate instruments requiring care in handling. Nevertheless these instruments must be shipped to the customer by all modes of transportation, to all parts of the world and subjected to the handling of untrained personnel. Packaging techniques, until recent years, have been accomplished purely by empirical methods. The need exists for a more comprehensive knowledge of the characteristics of package cushioning materials and the design techniques applicable to their use. The dynamic cushion tester was designed and developed specifically to satisfy this need and was based on the concept of optimum cushioning.

OPTIMUM CUSHIONING

Let us illustrate the concept of optimum cushioning with an example. Take a compression spring approximately six inches in diameter and a free height of six inches, similar to those used in the front suspension of many automobiles. Then place a rigid steel plate on top of the spring to serve as an impacting surface. Let us then take a safety pin, an automobile, and a locomotive and drop each of them in turn onto the spring from approximately six inches.

Now let us examine the results of our drop tests. The compression spring was much too stiff for the small weight of the safety pin and so the spring did not deflect to store the energy of the fall. Thus, the total energy of the fall was absorbed by the pin with resulting high loads. Since the compression spring was taken from an automobile, the spring deflects with the fall of the au -bile. Energy is stored by the spring and the load on the automobile is proportional to the stiffness of the spring and its deflection. For the locomotive, due to the extremely heavy mass, the spring deflects till the coils of the springs "bottom". In effect the energy of the fall exceeded the normal energy storage capacity of the compression spring, resulting in a high load on the locomotive.

Thus, for a given stiffness and free height of the spring, an "optimum" weight dropped from a given height will result in the maximum energy storage in the spring with a minimum restoring force applied to the weight. The spring

is then being utilized with the greatest efficiency. For package cushioning materials, the "efficiency" is a measure of the ability to temporarily store a large amount of energy with a minimum restoring force applied to the packaged item. By the proper selection of the most efficient material, a package design can be engineered to provide the required degree of protection with a minimum of package cubage and material cost. A measure of the efficiency has been defined by R. R. Janssen of North American Aviation, Inc. in a paper entitled "A Method for the Proper Selection of Package Cushion Material and its Dimensions", and is denoted as the optimum cushion factors.

DETERMINATION AND APPLICATION OF OPTIMUM CUSHION FACTORS

Excerpts from Mr. Janssen's paper will be used to illustrate the method of determining the cushion factors and their application to package design.

The optimum cushion factors are defined as J^{opt} and R^{opt}, where:

$$J^{opt} = \frac{f}{e}_{min} \qquad R^{opt} = \frac{1}{f} \text{ at } \frac{f}{e}_{min.}$$

where: f = force per unit area = $\frac{F}{A}$

e = energy per unit volume = $\frac{E}{V}$

and: $V = AT$

Thus,

$$J^{opt} = \frac{\frac{F}{A}}{\frac{E}{AT}} = \frac{F}{E}_{min} \times T \qquad R^{opt} = \frac{A}{F} \text{ at } \frac{F}{E}_{min.}$$

A compression test on a cushion material specimen will result in a force-displacement curve as in Figure 34. The energy storing capacity is the area underneath the curve. In Figure 1, E denotes the energy storage for force, F. Similarly for each increment of force the corresponding energy storage may be determined, and a curve of energy vs. force may be plotted as in Figure 35. Now from Figure 35, the ratio of force to energy may be determined for each increment of force and a curve of F/E vs. F may be plotted as in Figure 36. As indicated in Figure 36, a minimum F/E occurs at a force F. Thus, with these values of F/E and F and the dimensions of the cushion specimen, the optimum cushion factors are determined from the equations previously developed.

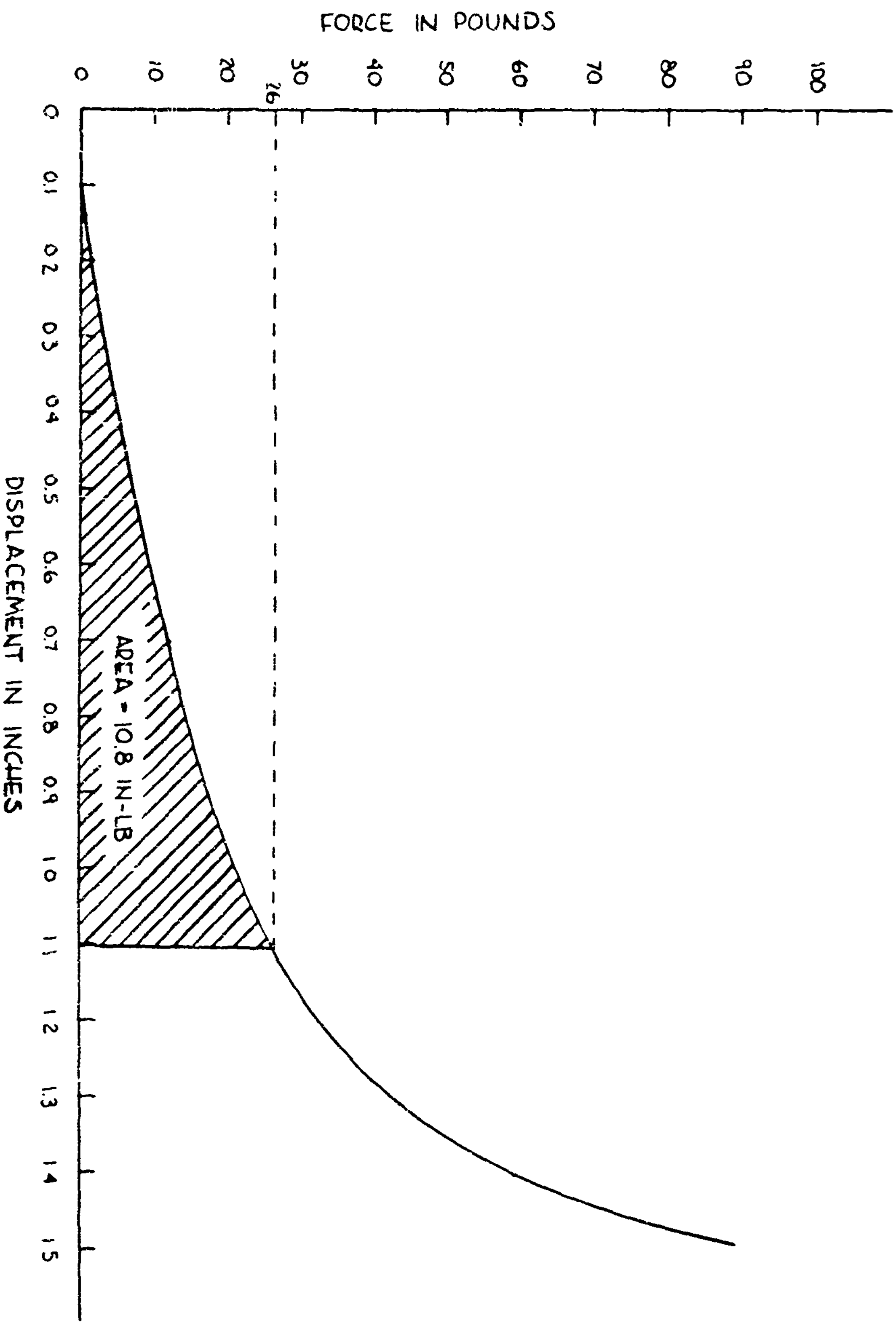

FIGURE 34 FORCE-DISPLACEMENT CURVE FOR A PACKAGE CUSHIONING MATERIAL

FORM D 18 G 13 REV 12 64 FORMERLY D-18-G-3(V)

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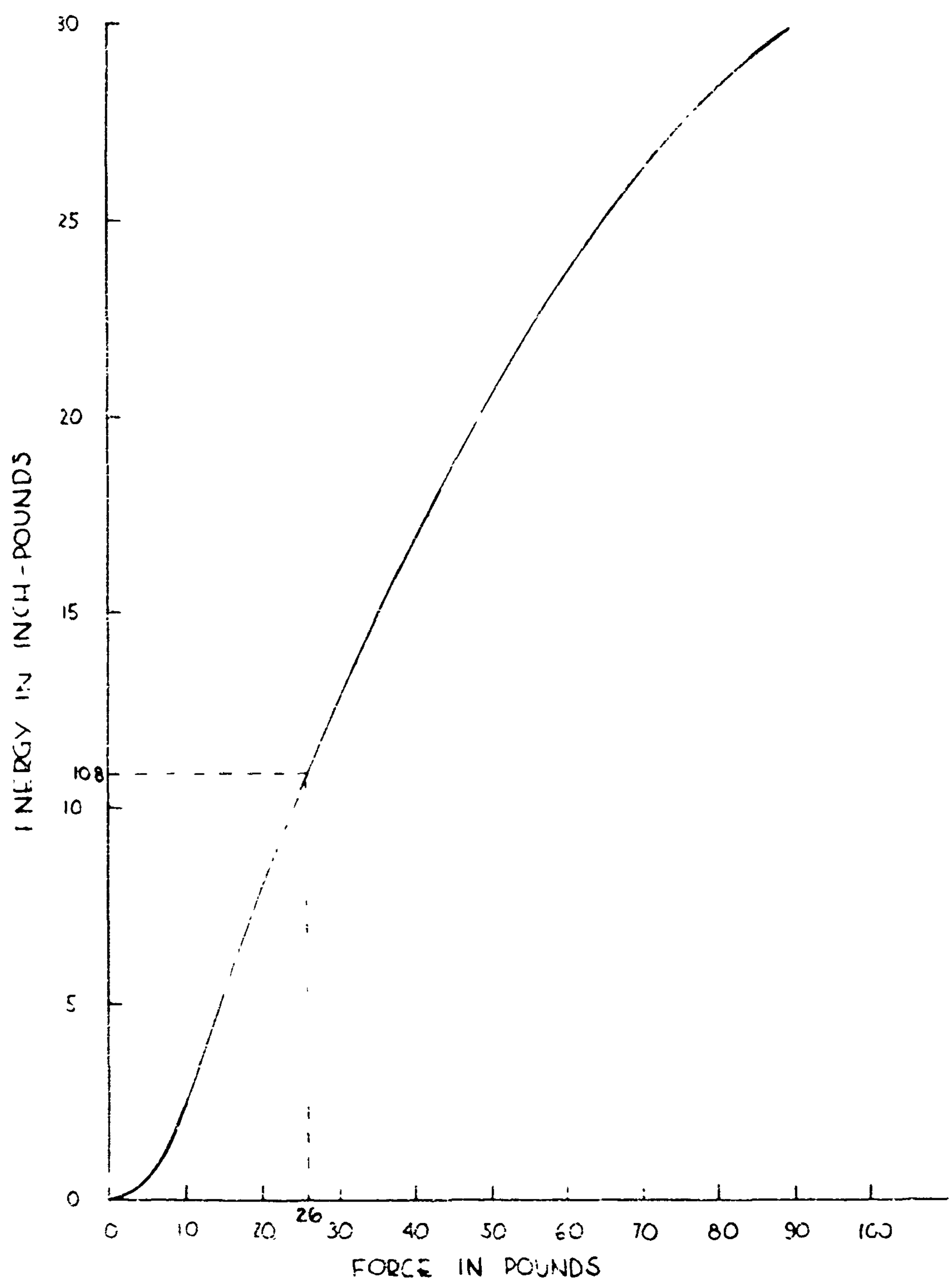


FIGURE 35 ENERGY-FORCE CURVE

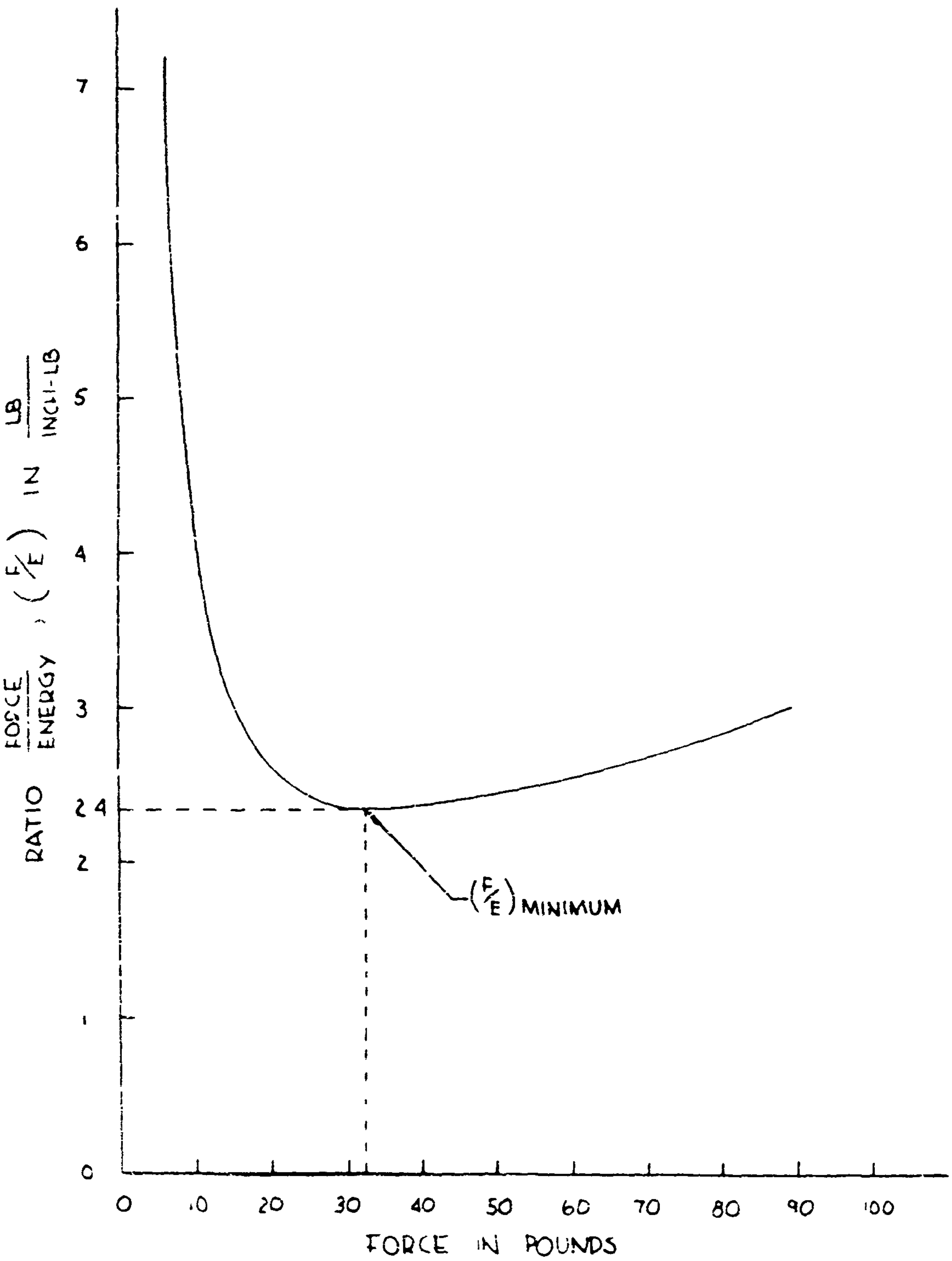


FIGURE 36 RATIO FORCE TO ENERGY, (F/E) VS FORCE

The use of these factors in actual package designs can be effected by the following substitutions:

$F = WG$ where W = weight of suspended mass

$E = Wh$ (1) G (2) = ratio of acceleration of item to acceleration of gravity

h = drop height

Then:

$$J^{opt} = \frac{WG}{Wh} \times T = \frac{GT}{h} \qquad R^{opt} = \frac{A}{WG}$$

By transposing:

$$T = \frac{J^{opt}h}{G} \qquad A = R^{opt}WG$$

and

$$V = AT = R^{opt}WG \times \frac{J^{opt}h}{G} = J^{opt}R^{opt}Wh$$

Thus, with the use of these two simple algebraic expressions, the cushion dimensions may be determined and utilized to obtain the required protection with a minimum of cushion material and package cubage.

STATIC VS. DYNAMIC OPTIMUM CUSHION FACTORS

The optimum cushion factors, J^{opt} and R^{opt}, were determined by a slowly applied load, whereas, under actual conditions of handling and transportation shocks, the load is

---

(1) In reality, $E = W(h + d)$ where d = deflection of cushion. However, when d is small in comparison to h, it is usually neglected.

(2) $G = G' + 1$ where G = effective dynamic acceleration which is the sum of its dynamic acceleration (G') and the static weight of the component. (Reference NAA Report NA-54-727 "Some Important Factors in the Selection of Distributed Cushioning Material" by H. Himelblau, Jr.)

applied in a short increment of time. Drop tests of weights onto cushion specimen indicate a marked difference in cushioning properties from those determined statically. The fundamental difference between the two methods of testing is the rate at which the load is applied. Assuming that viscous or velocity damping takes place within the material, the damping force is then affected by the rate of loading. The magnitude of the damping force has a decided effect on the acceleration-time characteristics as discussed in the "Dynamics of Package Cushioning" by Dr. R. D. Mindlin. Thus, with package drop tests used as a criterion of performance and the presence of viscous damping in package cushioning materials the dynamic rather than the static optimum factors should be determined.

DESIGN OF A DYNAMIC CUSHION TESTER

There are, at present, three basic types of dynamic testers:

(1) Free-fall of weight and cushion specimen as a unit.
(2) Pendulum method.
(3) Free-fall of weight onto a cushion specimen.

The dynamic cushion tester designed and built at NAA, Inc., is based on free-fall of weights on cushion specimen and is illustrated in Figure 37.

BASIC CONSTRUCTION

Basically the tester consists of a vertical raceway (2), impact head with two impacting surfaces (3), a release mechanism (4), adjustable to any desired drop height and a rigid base (1). Numbers in circles are referred to Figure 37. The vertical raceway is constructed of 4130 steel, 2 x 2 x 45 inches long. A maximum drop height of 30 inches can be attained for a 5 inch thick cushion specimen. The impact head is of 24ST4 aluminum alloy plate, chemically milled to decrease the weight without loss of structural rigidity. Figure 38 illustrates a close-up view of the impact head. Ball bearings are used to decrease friction and an adjusting screw has been provided to loosen or tighten the bearings on the shaft. Two impacting surfaces have been provided to eliminate any "Cocking" of the head during the fall and rebound. The studs on the head are for the addition of calibrated weights. Two heads have been fabricated, one designated a light head weighing approximately 4 pounds and a heavy head weighing approximately 7 pounds. A third head, weighing approximately

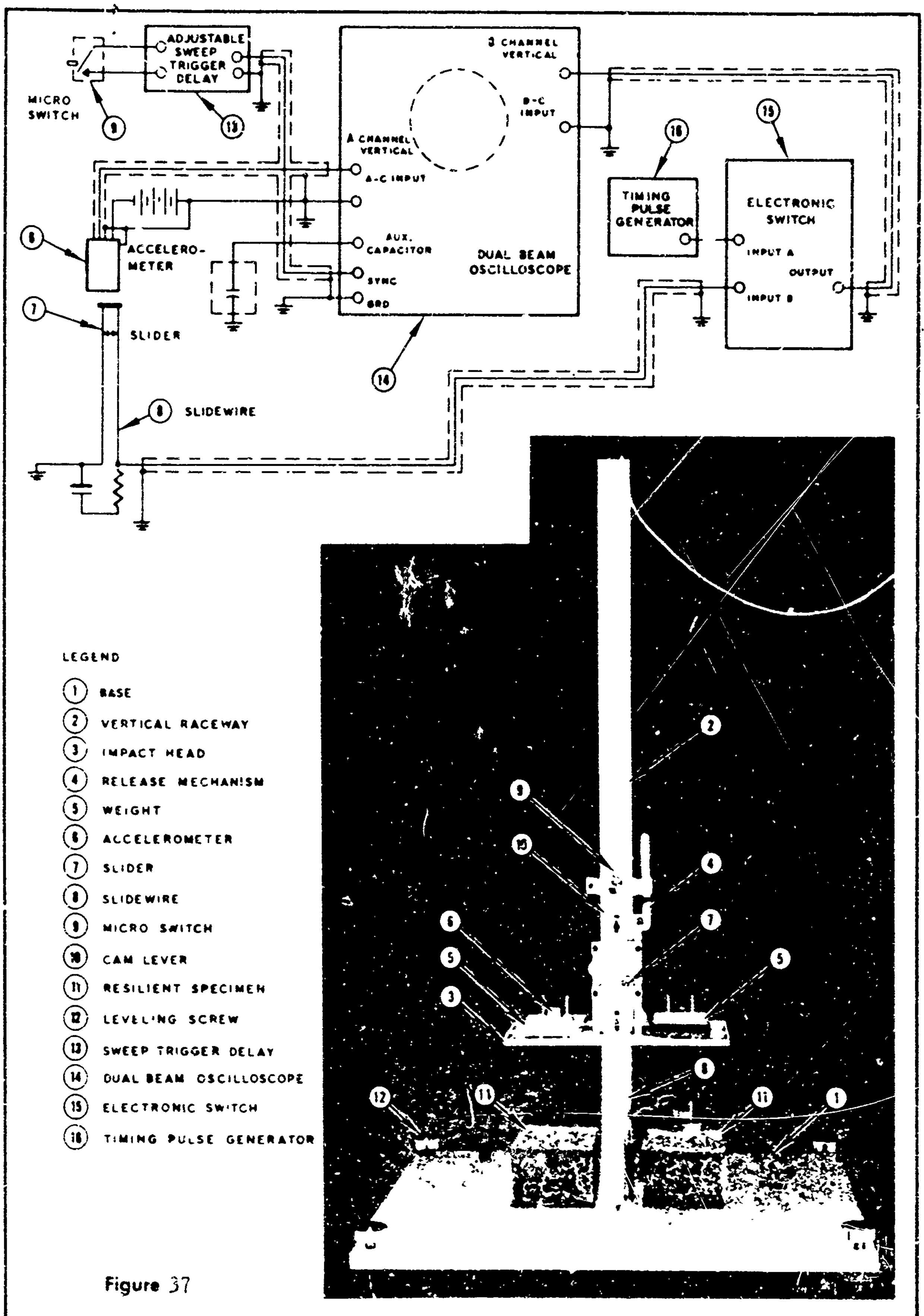

ADJUSTABLE SWEEP TRIGGER DELAY
MICRO SWITCH
B CHANNEL VERTICAL
D-C INPUT
A CHANNEL VERTICAL
A-C INPUT
AUX. CAPACITOR
SYNC
GRD
DUAL BEAM OSCILLOSCOPE
TIMING PULSE GENERATOR
ELECTRONIC SWITCH
INPUT A
INPUT B
OUTPUT
ACCELERO-METER
SLIDER
SLIDEWIRE
LEGEND
1 BASE
2 VERTICAL RACEWAY
3 IMPACT HEAD
4 RELEASE MECHANISM
5 WEIGHT
6 ACCELEROMETER
7 SLIDER
8 SLIDEWIRE
9 MICRO SWITCH
10 CAM LEVER
11 RESILIENT SPECIMEN
12 LEVELING SCREW
13 SWEEP TRIGGER DELAY
14 DUAL BEAM OSCILLOSCOPE
15 ELECTRONIC SWITCH
16 TIMING PULSE GENERATOR

Figure 37

9 of 22

2 pounds, is being fabricated to ermine the optimum factors for light density materials. Weights can be varied in one pound increments to approximately 52 pounds. The base is 30 x 22 x 1 and constructed of 1020 steel. Leveling screws have been provided at the 4 corners of the base.

INSTRUMENTATION

An accelerometer (6) mounted on one side of the impact head and counterbalanced by an equal weight on the other side is used to indicate the dynamic response to the impact which is recorded on the cathode ray oscilloscope. A slider (7) is located on the impact head and the slidewire (8) attached to the lower portion of the shaft provides for displacement measurements on the oscilloscope. A time calibrated sweep will be used in the oscilloscope to obtain both acceleration-time and displacement-time characteristics. The entire response will be recorded permanently by an oscillograph camera attached to the oscilloscope screen.

OPERATION OF TESTER

Two cushion samples of the same size from the same sheet are placed on the base directly beneath the impact head. The impact head is raised to the pre-determined drop height and fixed in position by the release mechanism. A cam lever (10) attached to the impact head contacts a micro-switch (9) on the release mechanism. As the release mechanism is tripped, the head falls freely and the cam lever opens the micro-switch which triggers the sweep through the oscilloscope. The accelerometer signal is fed to the vertical grid of the cathode ray tube. An adjustable sweep trigger delay is included in the circuit to time the sweep with the instant of impact. Thus, the acceleration pulse can be centered on the oscilloscope screen at any desired drop height.

As the impact head falls and strikes the cushion specimen, the slider on the head contacts the slidewire generating a second signal through the oscilloscope. The slidewire and slider form a linear potentiometer and as the slider travels down the slidewire, a change in voltage is effected and is seen as the image pattern of the head displacement on the specimen.

The optimum cushion factors will be determined following the procedure illustrated with the example of the safety pin, automobile and locomotive. A drop height of 30 inches has been generally accepted as a condition of rough handling. Maintaining a constant drop height of 30 inches, weights will

be dropped and a curve of G vs. weight will be plotted to obtain an optimum weight as in Figure 39. The optimum cushion factors may then be determined from:

$$J_D^{opt} = \frac{GT}{h + d} \qquad R_D^{opt} = \frac{A}{WG}$$

where subscript d denote dynamic optimum factors.

A typical oscillogram obtained for a drop is illustrated in Figure 40, showing maximum acceleration and displacement. Pulse shape and pulse duration may also be determined from the oscillogram. Free vibration tests can also be performed and the natural frequencies for increments of loads may be determined by counting the number of cycles over a duration of time. Also from the decay curve, the equivalent viscous damping ratio may be determined.

CALIBRATION OF TESTER

In order to determine the magnitude of the frictional losses and also to view visually the dynamic loading, high speed films were taken, using an Eastman Kodak camera. Runs were made at 3000 frames per second for black and white and 250 frames per second for color. The film was then analyzed frame by frame to determine the velocity at impact. The velocity was then compared with the theoretical velocity for a 30 inch free-fall, 152.1 inches per second. It was found that the frictional losses would require a slight compensating increase in drop height. Analysis of the film led to the development of one further improvement.

A velocity measuring device was developed consisting of contacts embedded alongside the slidewire. These contacts were spaced approximately 1/2 inch apart and the distance measured with a dial indicator to an accuracy of one ten-thousandths. These contacts were then connected to a series of terminals. Two leads from an electronic counter pick up any two terminals. As the slider slides over the contacts, the counter measures the time for the slider to pass from one contact to the other to one micro-second. Thus, the velocity at impact can be determined very accurately and any minor compensation for frictional losses can be effected.

APPLICATION OF OPTIMUM DYNAMIC PROPERTIES TO PACKAGE DESIGNS

The shape of the G vs. W curve is very important in the application of the material to package designs. For a material exhibiting a G vs. W curve similar to curve A of Figure 41 with a sharp optimum point, any deviation from optimum would

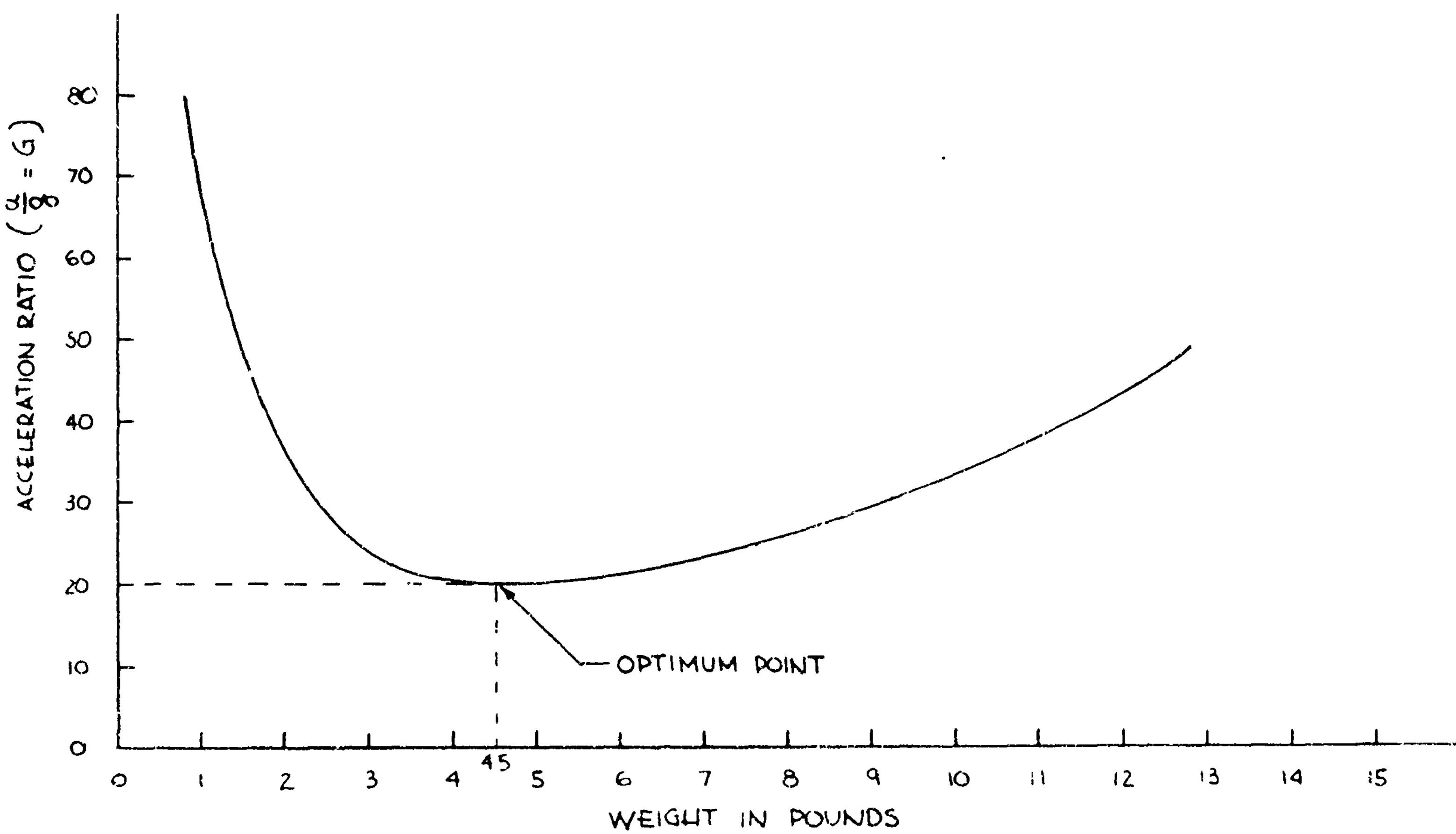


FIGURE 39 ACCELERATION RATIO, G VS. WEIGHT, W FOR A 30 INCH FREE FALL (THEORETICAL)

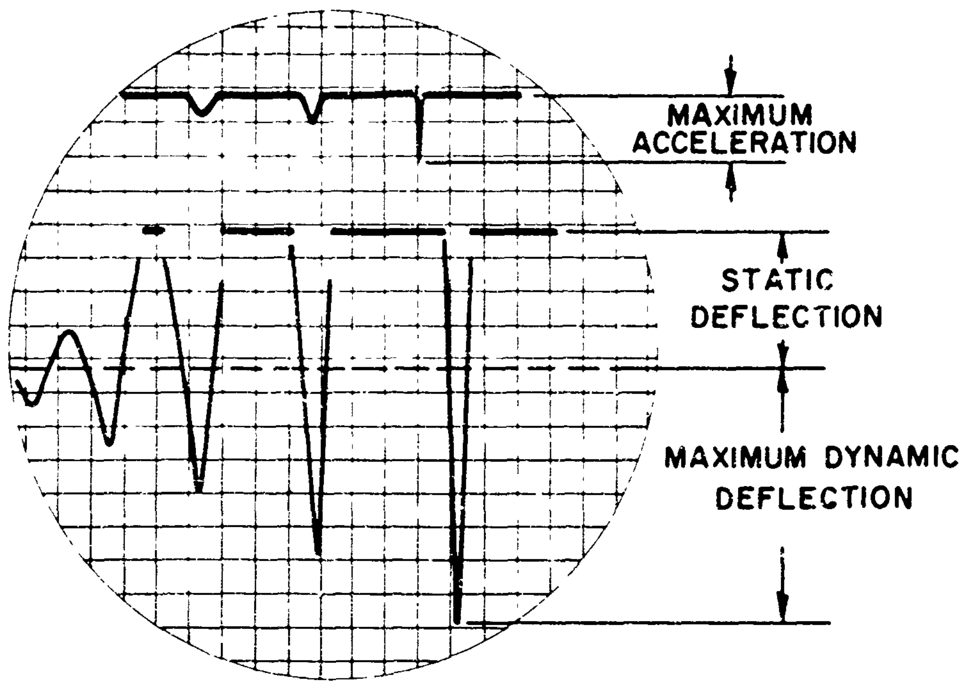


FIGURE 40 TYPICAL OSCILLOGRAM OBTAINED USING THE DYNAMIC CUSHION TESTER

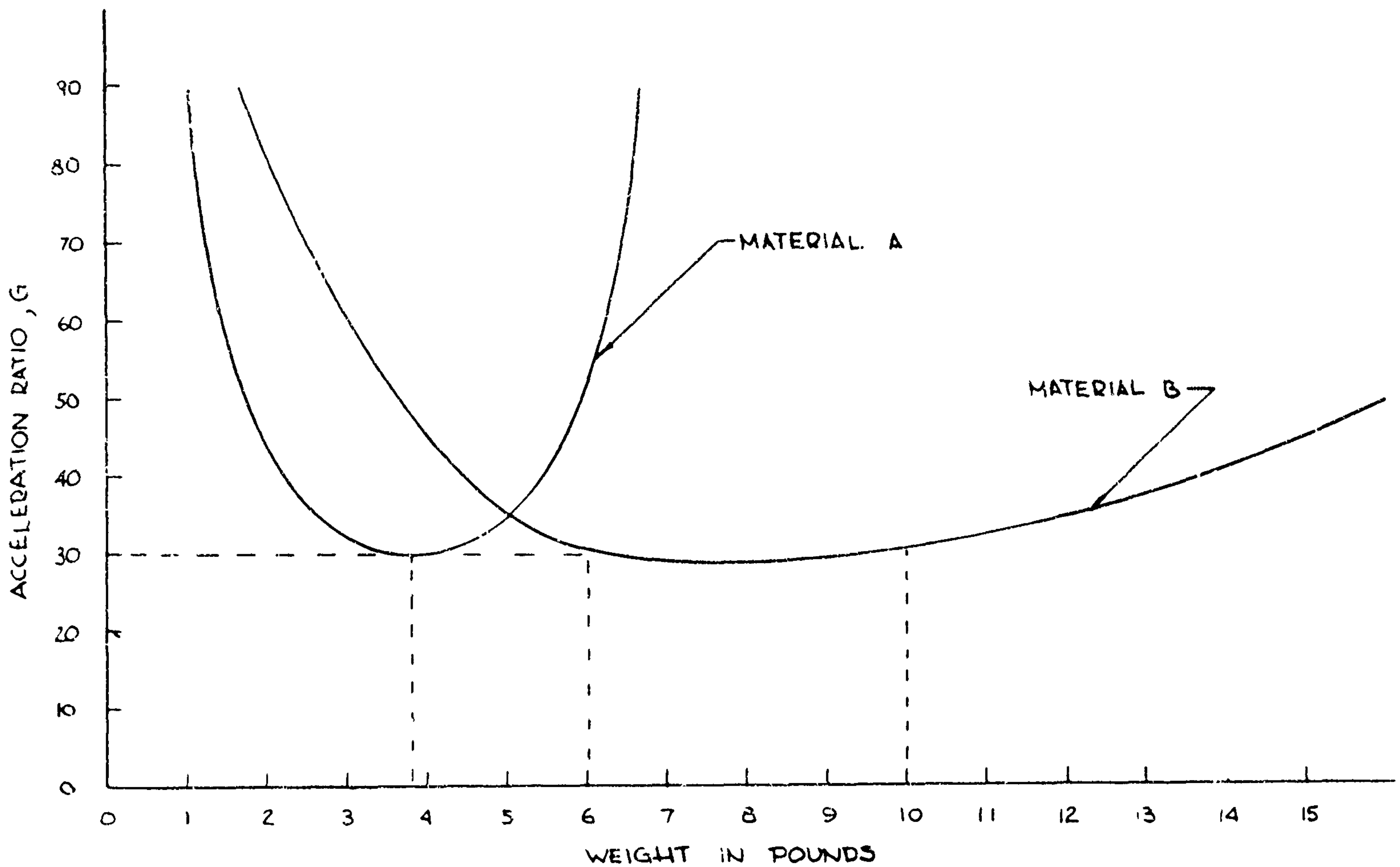


FIGURE 41 THEORETICAL G VS W CURVE FOR TWO PACKAGE CUSHIONING MATERIALS FOR A 30 INCH FREE FALL

result in a rapid increase in load to the packaged item. Whereas, for a material with curve B, the J_D^{opt} remains relatively constant for a range in R_D^{opt} from W_1 to W_2. Thus, one cushion design for a particular allowable load and drop height may be used for a suspended mass of range W_1 to W_2.

The use of the dynamic optimum cushion factors will lead to the minimum cushion thickness for a given allowable load and drop height. However, circumstances may arise for deviation from optimum conditions in order to effect a better design. For example, use of J_D at point A on Figure 42 would result in an increase in J_D and R_D from optimum. This condition may be desirable where the increase in thickness will be offset by the increase in bearing area required, thus, leading to a more stable package. At point B of Figure 42, J_D increases and R_D decreases from optimum resulting in an increase in required thickness and a decrease in required bearing area. If the product of J_D and R_D is less than the product of J_D^{opt} and R_D^{opt}, the result would be a decrease in the amount of package cushioning material required. Thus, this condition may be used where the savings from the material cost is greater than the cost of the increased cubage.

Upon determination of the cushion factors for a material, the dimensions of the cushion may be calculated for a given allowable load and drop height. Having determined the cushion dimensions, the next problem is to devise a method for securing the cushion pads so that the packaged item is fully supported. Several methods have been developed and are in use at NAA, Inc.

One of the first methods was the use of die-cut corrugated "trays" to secure the pads in position. This is illustrated in Figures 43 and 44. The use of this method is restricted to high production parts where the cost of the dies would be easily absorbed. It is also advantageous to utilize this method for packaged items of square configurations. In this way, one size of trays can be utilized for all six sides of the package.

The most adaptable method is the use of hair latex corner pads. This is illustrated in Figure 45 and consists essentially of an L section of hair, slitted to form 3 rectangles. The slits allow the bending of the hair to form a corner as shown. Eight corner pads are required for a package and is shown in Figure 46.

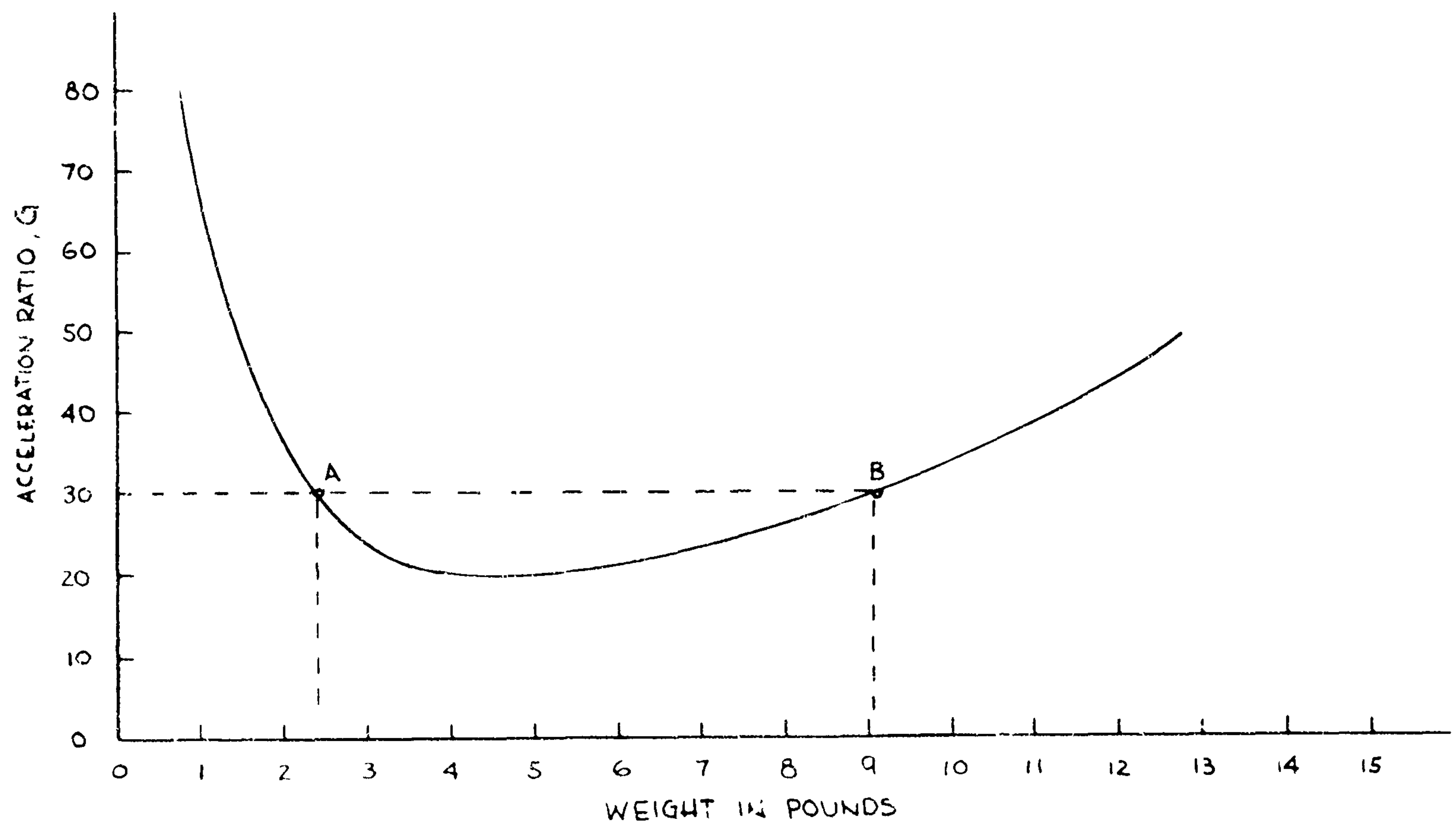
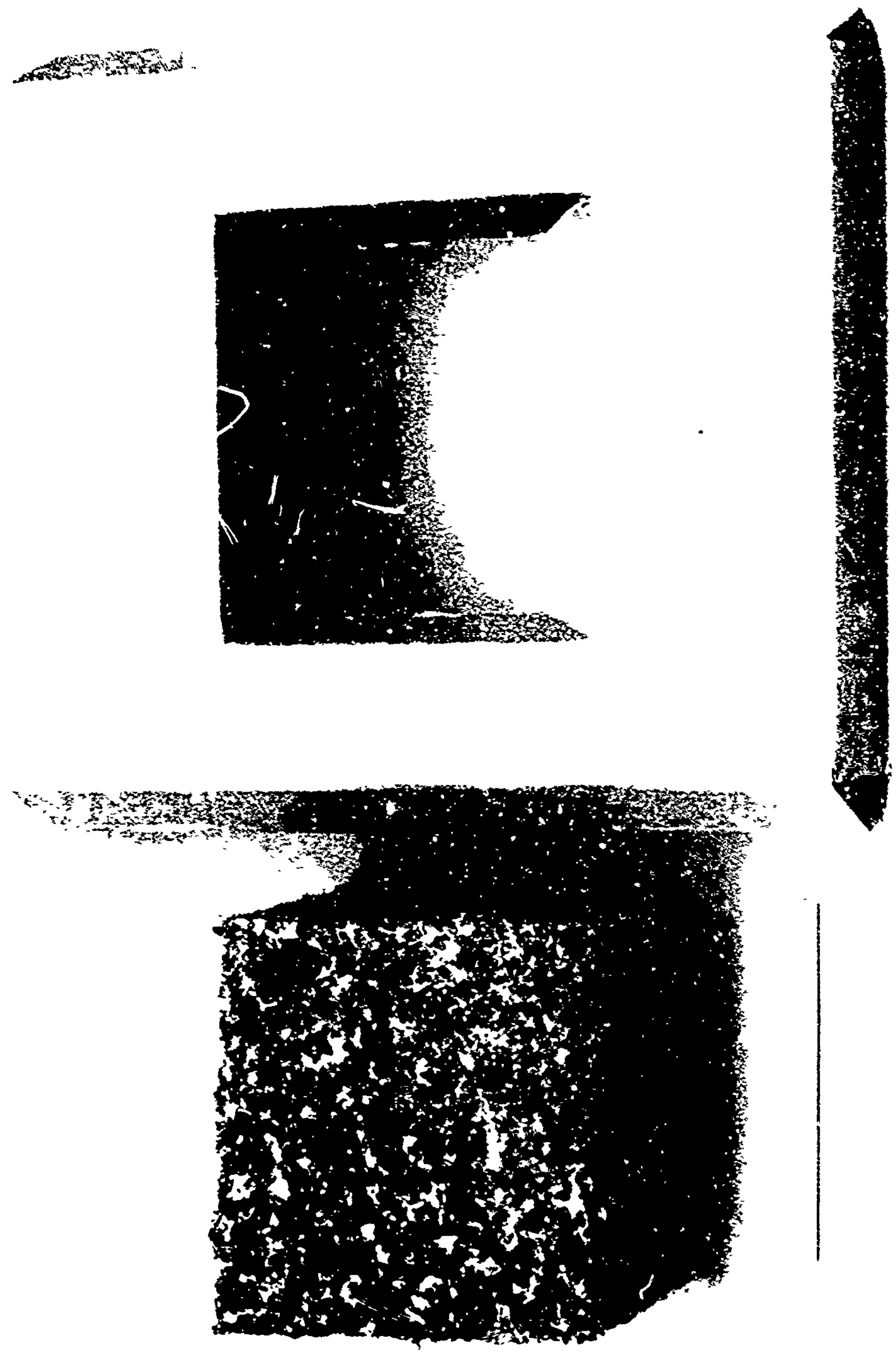


FIGURE 1.12 THEORETICAL G VS W CURVE ILLUSTRATING DEVIATION FROM OPTIMUM



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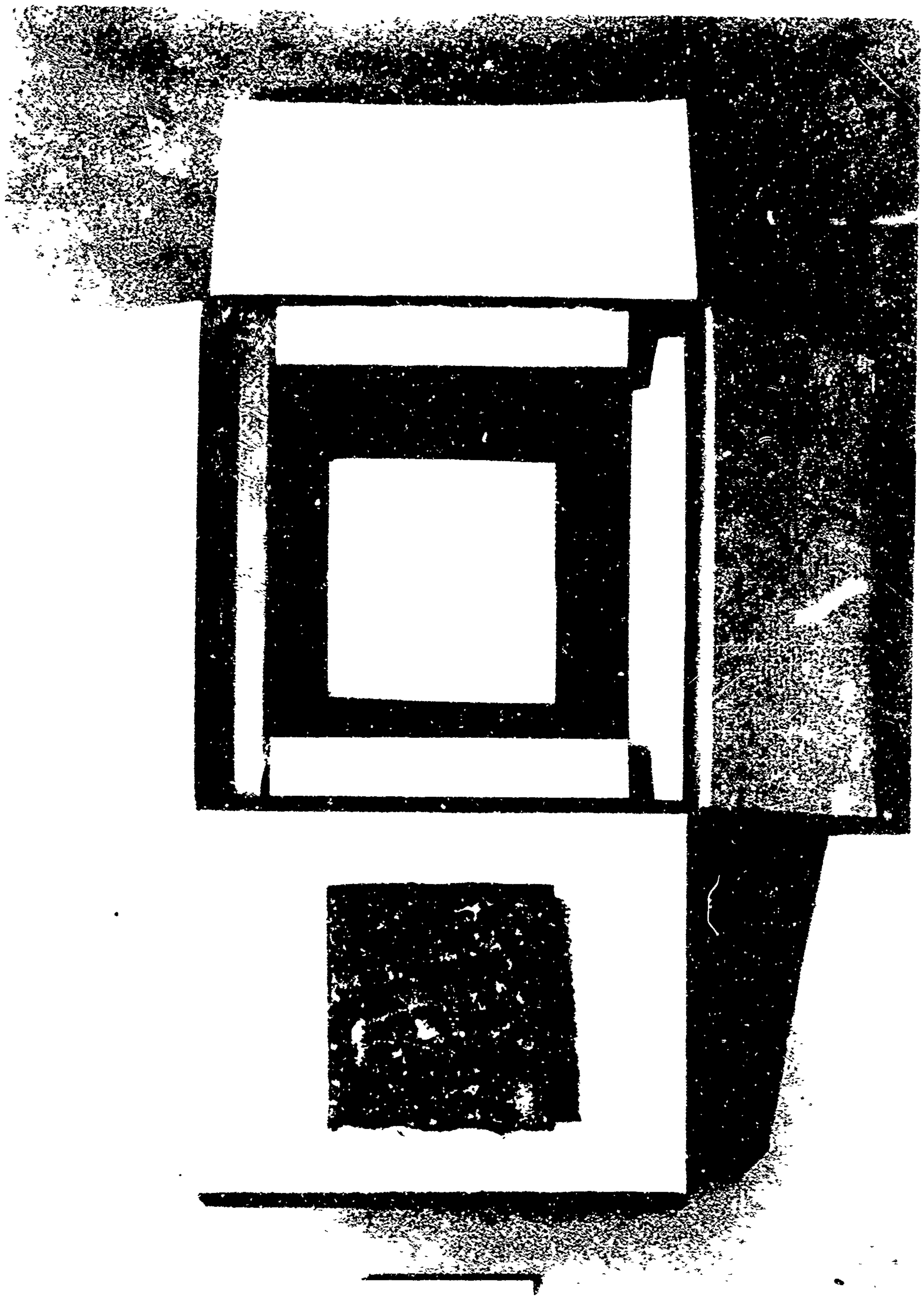

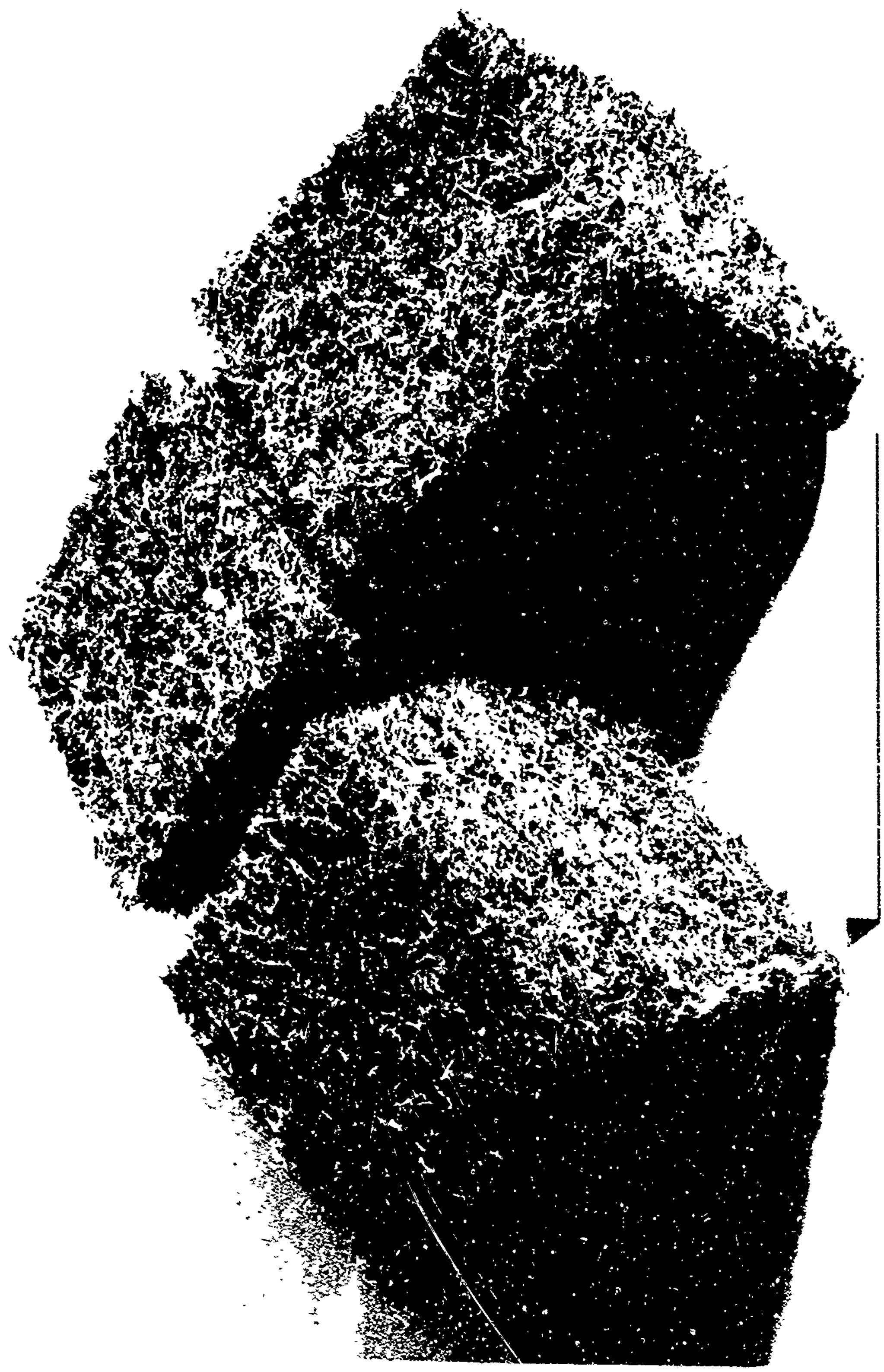

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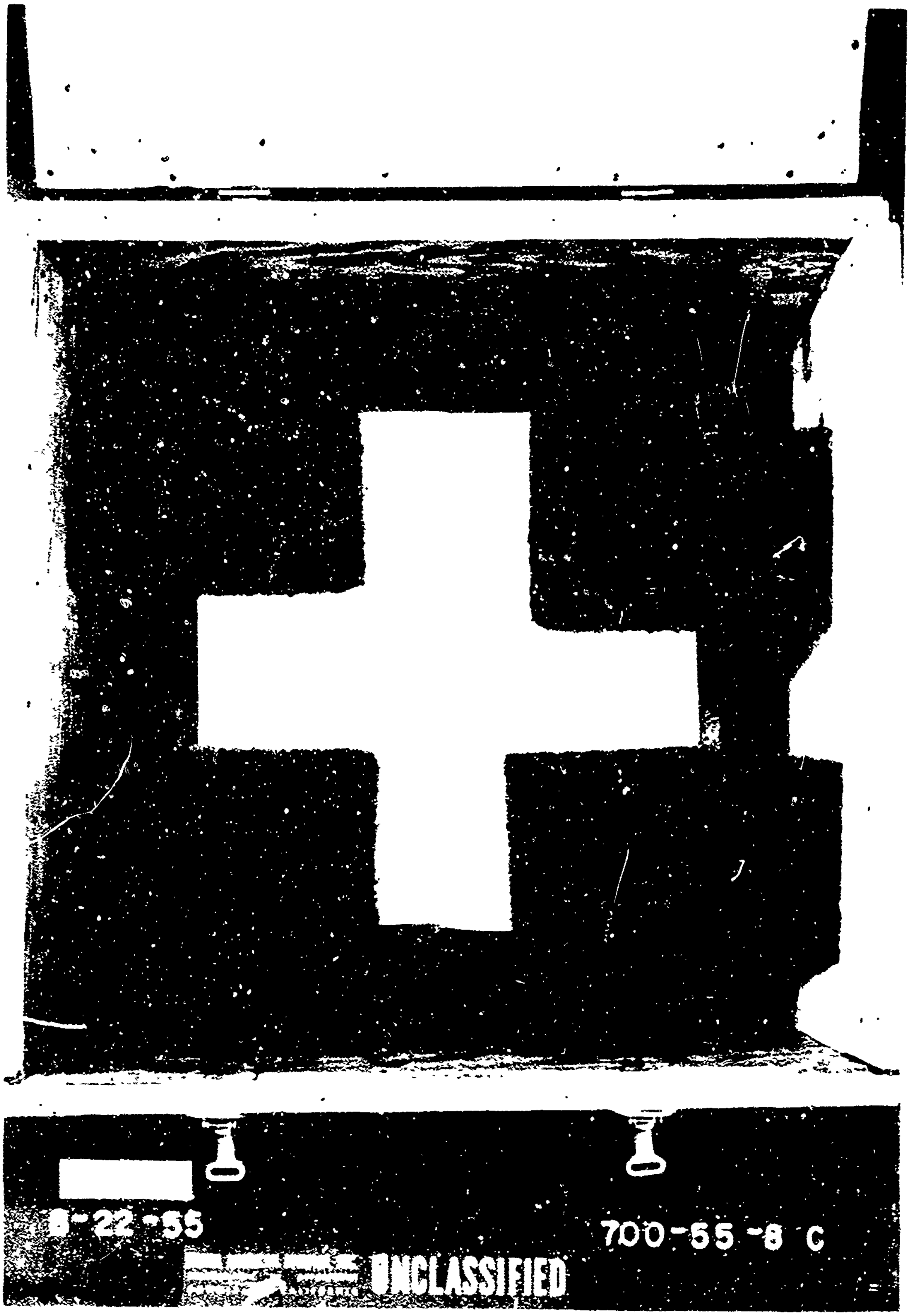
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CONCLUSION

Many package cushioning materials of varying properties are presently available. The optimum cushion factors provide a measure of the cushion properties and application to package design. The dynamic cushion tester can be used to determine the dynamic optimum cushion factors to provide a more efficient use of the materials and a more realistic condition to which packages are subjected. In addition, the tester will indicate the pulse shape and pulse duration of the response and the natural frequencies and equivalent viscous damping ratios may be determined. Thus, with packaging gaining more recognition as an integral part of the reliability of equipment, it is hoped that the developments presented will add one more step in the progress of packaging from an art to a science.

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Tuesday PM Oct. 11, 1955

New Developments in Materials Handling

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Editor, Modern Materials Handling

Suppose that tomorrow -- God forbid -- one of our radar outposts off the North Atlantic coast were to make contact with a fleet of unidentifiable aircraft approaching our shores. Within a matter of seconds our entire defense network would be alerted. Information on the number of these planes, their speed and current course would immediately be flashed to a central command post. Civilian defense agencies would be notified. And before minutes had passed, our armed interceptors would be dispatched to seek out and destroy the probable enemy.

In the meantime, based on supplemental data, the central area command would determine -- probably by electronic computer -- the ultimate defense to meet this threat, and order additional military forces into action.

Now stripped of all verbage, what would we have done. Gentlemen, we would have placed an order for material and have had it delivered.

How fast and how efficiently we deliver material in event of another war may well determine whether we continue to exist. Not whether we continue to exist as a world power or as a nation, but whether we continue to exist at all.

This is no new idea. The success of every military operation in history has been based on two fundamental concepts: (1) having the right material at the right place at the right time; and (2) using it more intelligently than the enemy. And having more than enough of the right material at the right place ahead of time always provides a comfortable margin of safety.

Efficient distribution is no less important to an industrial organization than to a military organization -- especially when you consider that 100 percent or more is frequently added to the cost of a product between the manufacturing area or processing line and the customer's back door. It makes no sense to squeeze pennies from the cost of a product through redesign and better manufacturing methods, and not devote at least equal attention to distribution, which today provides a far bigger area for cost reduction.

Thus, from the standpoint of both the military and industry -- or, putting it another way, from the standpoint of both time and cost -- distribution certainly is worthy of study. And since materials handling is an integral part of distribution, it is receiving much thought and scrutiny. In my opinion, the developments in this phase of materials handling will, within the next few years, be equally as dramatic and as significant as is automation in manufacturing -- both from the standpoint of equipment and methods.

Already a great deal has been done, and many trends are apparent. Consider, for example, the first area on the outbound side of manufacturing: the warehouse and storage facility. Engineers have their factors of safety. Budget directors have their columns for miscellaneous expenditures. And production planners and market analysts have the warehouse to fall back on. It's the "fudge factor" in the production-distribution cycle. Because of variables in demand, we will always have it ... we can't get rid of it ... but by better planning and new equipment we can change its size, shape, or character, thereby reducing the cost of its operation.

One way of changing the character of a warehouse is to adapt it for handling only one size of unit -- a pallet load for example. It's always easier to handle all of one type of unit than a miscellaneous assortment. So, if between the end of the production line and the warehouse we place accumulating conveyors and palletizing machines, the piles become fewer in number, more uniform, better adaptable to machine handling, and therefore more mobile and less static.

Palletizing machines are increasing in number, use, and importance. Semi-automatic and completely automatic models... capable of handling an infinite variety of pallet patterns... at rates of from 1000 to 1500 cases or cartons/hour ... are now available from a number of manufacturers.

Perhaps the largest single installation at the present time is in the H. J. Heinz plant at Pittsburgh, Pennsylvania. At this plant, accumulating conveyors are installed on the output side of case sealers on each of thirteen production lines.

The production lines do not always make the same product. Both the product and size of carton may change from day to day -- and production rates on different products

vary. So the problem was to provide sufficient flexibility in the conveyor system to combine the outputs of the thirteen lines and feed them into the four pallet loaders in the correct combination to keep the machines operating at full capacity.

This was accomplished by running four trunk line conveyors underneath the accumulating lines. Each of these trunk lines, which is simply a transportation conveyor, feeds directly into a pallet loader in a warehouse, some 800 to 900 ft. distance from the production building. Any one of the thirteen lines can be tied in with any one of the trunk line conveyors by setting up the required combination on a central control panel.

The way this actually is done is by means of cylinder actuated deflector plates on the belt conveyors that are adjacent to the metering belts. Chutes that drop down to the trunk line conveyors are opposite each of these deflectors. When the metering belt on the accumulating lines is started, the chute drops down and the required number of cartons are counted as they pass the phototube, after which the metering belt is stopped and the chute automatically retracted so that other cartons can pass beneath it.

A control station for the pallet loaders is located in the warehouse. Whenever a full pallet load comes through on a trunk conveyor, the operator energizes the cartridge on the pallet loader, which goes through its cycle. The full pallet is discharged from loader directly to a reciprocating vertical conveyor, where it is automatically carried to the floor on which it is to be stored, and discharged.

So here is one type of equipment for changing the character of a warehouse. But suppose that the unit to be stored is too large or awkward to palletize by one of these machines? Then you can crate or box it with automatic packaging equipment, and still handle it without difficulty. I am sure that Mr. Putnam can tell you much more than I about the development of packaging machines -- not for items like food cans or drugs -- but for refrigerators, washing machines, and products of like weight and bulk. I would just like to say that this is a concept of extreme importance to both our military establishment and to industry.

From such packaging machines, products can be carried by conveyor to accumulating lines in the warehouse, and from

there to the shipping dock. GE does this at Appliance Park in Louisville.

A somewhat different approach was taken by Lincoln Electric in its warehousing operation. In this plant, an accumulating conveyor system is used to collect truck shipments. A slat type conveyor, with a control element on each slat, runs the length of the welding machine warehousing area. The control dial on the pan is set for any one of seven truck accumulating lines. When a welder weighing several hundred pounds is set on the conveyor, it is trans ported to the shipping area, cross-shunted to the proper accumulating conveyor, and automatically discharged on it.

Now, if we can make the loads coming into and going out of the warehouse fluid instead of static, why not make the entire warehouse so that storage is fluid? Why not tilt the floor so that new stock goes in the back, flows to the front, and is then removed? This is not a new concept. Harry Meserole proposed it back in 1946 in a booklet entitled "Streamlined Wholesale Grocery Warehousing".

While it is impractical to literally tilt the floor, stock can be loaded on inclined conveyors so that it flows from the receiving area to shipping as needed. Each individual rack or conveyor might be equipped with gates. A punched card or tape containing all of the information on any given order would actuate these gates, and the correct amount of material would flow to the conveyors and hence to accumulating points. As you are no doubt aware, a system had been developed for controlling conveyors by means of tape, so that a package placed at any point on the conveyor is automatically shunted to the correct accumulating station at the end of the line. In addition to this development, many independent groups are working on other types of controls, and also on designs for completely automatic warehouses. The problem is essentially one of cost justification, but certainly not many years will go by before we have numbers of such warehouses in operation.

Great improvements can be made with palletizing machines, large packaging equipment, and accumulating conveyors without going to complete automaticity in a warehouse. And other equipment, too, is rapidly moving into warehousing operations. A very intriguing development is the "operatorless" tractor train that follows low frequency radio signals in a wire that is strung overhead, buried in the floor, or placed along a wall. A servomechanism picks up the signals and steers the

tractor along the path of the wire. If the wire is strung along a wall, the servo is given a permanent deflection, and will keep the tractor within 3/4 in. of this deflected path. The servo also picks up any changes in direction of the wire, and will steer the tractor around a corner on an arc so that the trailers behind it will trail properly; the radius of this arc is adjustable. This particular tractor can be equipped with safety devices that will prevent it from running into other tractor trains, will job it around oncoming vehicles, or will stop it automatically at any station along its route. A number of tractors can, of course, be run on the same system.

Other types of automatic controls for tractor trains have been developed. One of these has a photocell type pick-up and servo control that follows a painted white stripe or tape on the floor.

Equipment of this type is ideal for a warehousing set-up or freight terminal operation that changes rapidly in size or shape. A tow chain conveyor might be impractical for such applications because of the time and money required to constantly modify it to fit changing conditions. With an automatic system such as described above, however, the wire or tape could be reeled in, cut or spliced, and re-routed along another path. It seems to me that the possibilities of these automatic vehicles for cargo ship and barge inloading are tremendous. The travel paths of the tractor trains could be changed hourly, if necessary.

I certainly do not mean to imply that a tow chain conveyor could not be designed with a similar degree of automaticity. It could be. As a matter of fact, I have a copy of a letter here with me today from the Chief Estimating Engineer of one of the large conveyor companies. The letter was addressed to Modern Materials Handling, and is dated February 2, 1953. Not only does this letter detail one - but several - methods of switching trailers from live to dead storage areas and back again using tuned oscillator circuits. Thus, the same degree of automaticity can be given to a tow chain conveyor as to a power and free conveyor system.

This same man then points out that, should complete automatic operation be undesirable, at least the truck might be equipped with a signalling device such as a bell that would ring when a trailer destined for a particular station came into the station area. It's a system like this that is

now in operation at the Federal Supply Center in Seattle, and there are no doubt others scattered around the country.

What can we do with these systems? We can mechanize the pile. We can reduce peak labor requirements by selecting in two hours what's needed for 24 -- and similarly reduce the labor required for stocking. With tape controlled conveyors, automatic bins, and secondary accumulation of product mix, we truly have a "turn-key" warehouse.

Another approach that can be taken to change the character of a warehouse is to move it outdoors -- to store in outdoor yards. A suitable building for storage costs a minimum of $4/cu.ft. if built specifically for this purpose, and probably on the average of $12 to $14/cu.ft. Thus, moving storage out into yards would reduce future capital expenditures for those companies that are faced with expanding both manufacturing and storage facilities because of increased production.

Many parts, materials, and finished products are stored indoors today simply out of habit. Indoors, they take up valuable space in buildings that might otherwise be used for production. They force management to invest in plant additions that might otherwise be unnecessary. They add to operating costs because of narrow aisles, cramped working conditions, and the supply of such services as heat and light. They are, to put it bluntly, a nuisance, an expense, and a headache.

There are, of course, always reasons why outdoor storage is impractical: (1) the material or product would deteriorate due to weather; (2) cold weather and snow would make winter operations difficult; (3) the cost of suitable yard handling equipment would require substantial capital outlays; (4) the yard is too far away from the plant.

But how real are these reasons? Great strides have been made in methods of protecting products, and even fibre board containers can be weatherproofed with plastic sprays or laminated with moisture proof outer liners. Not all yard equipment is costly -- and if it is, it can be leased instead of purchased. The problems of cold, snow, and long travel distances frequently can be overcome by proper planning and handling equipment.

Furthermore, many plants -- particularly the newer ones -- have large yard areas into which they can expand storage operations. And last but not least, equipment manufacturers now have or are developing the specialized types of handling devices that are needed for outdoor industrial -- and military -- operations.

The straddle carrier, for example is not new, but the way in which it can be modified and used is certainly worthy of re-examination. For transporting heavy loads from inside to outside, for carrying materials over long distances at speeds of 30 mph or more, or for moving hard-to-handle awkward shapes, the straddle carrier is often an ideal vehicle. It can put entire loads of palletized materials right outside of your plant door. It can even operate within the plant. At least one of the West Coast aircraft companies is using them in this manner, and it is my understanding that a special unit is being constructed for operation in the Calumet District Warehouse, which I previously mentioned. In addition, this vehicle can be used for over-the-highway hauling of small boats. It can carry large unit loads of goods direct to the retailers' front door. Several of the steel companies have found that these vehicles are excellent for transporting ingots, billets, plate, extrusions, pipe, and other items to and from the plant to remote yard locations, and from these yards to shipping areas. If the need is there, eight-wheel carriers of 100,000 lbs. or more capacity can certainly be built.

Today's carriers, too, may have considerable military potential. They might be used for yard handling or over-the-road transporation of multiple pallet loads or unit sized containers -- or for handling of aircraft pods -- or even for ship to shore transport. If necessary, the vehicles might be tractor mounted instead of wheel mounted. In short, gentlemen, the straddle carrier has many advantages, and may be but one of many special vehicles that will be developed for handling of large unit loads, containers, or shipping pods in the yard and over the road.

A somewhat different type of outdoor and over-the-road vehicle is the side loader. It, too, can pick up heavy loads and transport them at fairly high speed over long distances. Consider, for example, a king-sized pallet some 20 or 25 ft. long, with a roller conveyor bed. With a simple block for containing the loads, the entire unit can be moved to an airfield or freight yard by side loader. If a roller or wheel

conveyor bed were mounted in the carrier, the load could be transferred from the pallet to the carrier with considerable dispatch. Again, this vehicle can take many forms, including one with center mounted masts for handling guided missiles or one for both outdoor and indoor use. A prototype of such a truck, with only a 52 in. width, has been built and is being tested. Of course, this vehicle can stack, whereas the stacking possibilities of the straddle carrier are somewhat limited.

Other outdoor equipments that are getting or will get a new look include cranes and fork trucks -- specifically rough terrain fork trucks. Here, the trend seems to be away from the conventional lift truck mast and toward fork lever arms pivoted either on the side or the back of the vehicle. Most of these models have four-wheel drive through a torque converter and geared transmission. Some -- as, for example, the 6000 lb. model being built for the Canadian Pulpwood Association -- have four-wheel steer.

Why the emphasis on side or back mounting of the lever arms? One advantage is visibility. Another, and perhaps a much more important one is the range of attachments that can be added to such a vehicle, and in yard operations, flexibility in equipment often is all-important. For a small plant or for some military operations, it may be impossible to justify individual equipment for each operation. A single unit that can stack, be used for car spotting, do limited construction work, and handle bulk materials is fairly close to reality today. Several models now available can be equipped with a grab, a bucket, or a logging attachment. The bucket is controlled through full 360 deg. rotation by a hydraulic motor. The vehicle itself has four-wheel drive, four-wheel steer, articulated axles, and a hydraulic leveling system that keeps the truck body level when the vehicle is operating on a slope.

So far as cranes are concerned, the approach is toward smaller capacity, lower cost units. More wheel mounted models are being made -- in line with the industrial trend toward paved or semi-surfaced yard areas. Some of these cranes even look different. One unique design has an extendable, counterweighted boom. It has a capacity of 8000 lb. at a 10 ft. radius, an over-all height of 9 ft., and will travel under full load at 15 mph. Attachments include hydraulic outriggers, hydraulic clamshell and orange peel buckets, magnet front-mounted winch, load carrying platform, bulldozer and snow plow.

You can also do a lot with a standard crane. A fork attachment now is being built for one crane. The shovel boom, such as used on a 3/4 yd. shovel, is retained, as is the dipper stick, which can be moved back and forth. The shovel dipper is removed from the front end of the dipper stick and a set of "C-forks" is substituted for it. An additional device is added so that the forks can be revolved 360 deg.

My purpose in describing this equipment is not to impress you with any particular models -- many other types are available -- but simply to indicate the extent of the developments that are now taking place and to show you the possibilities that exist for lowering cost and increasing plant or warehousing by moving storage out into the open.

The objection that is always raised to outdoor storage is that the product or material deteriorates when exposed to weather. As I previously mentioned, much progress has been made with laminated fibreboard containers and plastic coatings. Several industry spokesmen have told me that, in their opinion, the packaging industry is certain to make much wider use of foil materials, particularly those which have been laminated to various forms of paper and/or plastic films such as polyethylene. These foil laminates provide both a good moisture barrier and a good thermal barrier. In the packaging of food stuffs and many types of military equipment, these are two points of prime concern. Containers of this type might be used for both storage and shipment.

This brings me to another point that I feel very strongly about: containerization. The signs definitely indicate that unit containers of one type or another will become the accepted accessory for shipment within a very few years. Consider just three straws in the wind: the joint Air Force-Army program of containerization for overseas shipment; Piggy-back and Fishy-back operations; and experiments by both shippers and the railroads with container cars.

Currently, the Army Transportation Corps in cooperation with the Air Force, has some 20,000 steel containers approximately 6 x 6 x 8 ft. that are being used experimently for overseas shipment. These are weatherproof, have a door running nearly the full height of the container, and can be loaded at a density of about 30 lb/cu.ft. to a total capacity of 9000 lb.

Studies that led to this program are quite revealing. Statistics show that about 42% of all items needed in the field consist of small boxes that are subject to palletization or containerization. In addition, another 25% of the material is such that it can be rolled on and rolled off of ships. This immediately promises to provide a significant reduction in loading and unloading time.

The Army is finding that out of the 295 cu.ft. of space available in the container and of the 365 cu.ft. of space it occupies in the hold of the ship, only 222 cu.ft. are being utilized due to voids and odd sized packages. But the boxes need not be packed for overseas shipment, so there is a significant savings to begin with. Furthermore, if the materials were so packed, they would occupy 315 cu.ft. of space, and this figure would be ballooned out by 15 percent when the boxes were stacked.

So the amount of space required for each type of shipment is about the same. But containers can be loaded at a rate of from 90 to 100/T/hr, loose packages at a maximum of 25/T/hr. When you figure ship demurrage at somewhere around $750/day on foreign ships and nearly $2000/day on American ships, you begin to appreciate the savings that can be made.

The Army does not plan to use these containers for domestic shipment. But many industrial companies are using or experimenting with various commercial containers that are available. And then there is "Piggy-back" and its sea-going counterpart "Fishy-back".

As you know, some 39 railroads now conduct "Piggy-back" or trailer on flat car operations. Only two of them, however -- the New Haven and the Pennsylvania -- are hauling other than their own trucks in any quantity. Most of the others are hauling their own trailers, which is a little bit like taking in your own wash. But they will get in, I'm certain, because the advantages of such operations for long haul transportation are fairly obvious. Here are just a few of them:

(1) Faster transportation.

(2) Fewer tractors. There's no need for a tractor for each trailer.

(3) Lower license fees. A trailer in service between Chicago and New York no longer needs plates for

each state in which it operates.

(4) Greater flexibility in trailer size and weight once the vehicle does not travel over the road in states imposing severe limitations.

(5) Less wear and tear on equipment.

The Pennsylvania, which inaugurated rail-trailer operations just a few months ago between Chicago and New York has found the growth in business fabulous. I do not know what current statistics are, but the week of September 7 the Pennsylvania hauled over 500 trailers between these two cities. My information is that such service soon will be -- or perhaps already has been -- launched between Pittsburgh and New York, and that tentative agreements have been reached to bring at least a train-a-day from the South to northern Metropolitan areas.

So it certainly looks as though rail-trailer operations will become an important method of transportation in the near future. It may interest you to know that over the past 20 years some 286 container systems have been proposed in this country, and that none of them became commercially important because they did not have the inherent service benefits necessary to interest a wide segment of American business. With rail-trailer systems offering the flexibility of door to door transportation and high speed service, this deterrent has been overcome.

Another approach to "Piggy-back" is the Mobilvan system, which utilizes a sealed container 17 x 3 x 8 ft. without wheels. The 17-ft. length permits loading of three vans on a standard railroad flat car which is 53 ft., 6 in. long. Two units can be transported on a conventional 35-ft. highway semi-trailer and one on a city delivery flatbed truck. A heavy-duty 30,000 lb. capacity fork lift truck or a large straddle carrier can be used to place the van on the truck or flatcar.

Key to the system is the van's automatic locking device that secures the unit. The release mechanism is automatic too. It operates when the forks of the lift truck or the clamps of the straddle carrier engage the van to remove it from the carrier.

The advantage of this system over conventional rail-trailer operations is that the vans are less costly than

trailers, and the absence of tamden wheels and axles reduces the weight by several thousand pounds. In addition, the vans can be used as outdoor storage containers until needed in the shop, then placed on a dolly and hauled directly to point of use.

From a military standpoint, the vans might be used as portable communications centers, portable hospitals, mobile machine shops, or in many other ways. Their possibilities for portable postal stations might also be worthy of study.

The status of this system at the present time is that Freuhauf has signed a contract to build the units, and Clark -- the developer -- has offered to equip rail cars with the locking device at cost.

Of course, rail movement is not the only method of transportation that can be employed for trailer or Mobilvan transport. The "Fishy-back" operation recently received impetus when the McLean trucking interests announced plans for building seven special vessels for trailer transport service up and down the east coast.

Of course, Sea-Train also has ICC permission to operate along the coast, and while the cargo now consists only of freight cars, this company might be another entry in the "Fishy-back" business. Incidentally, it may interest you to know why Sea-Train always leaves New York with a full load. It isn't only a matter of cost. Sea-Train will deliver a rail car in Savannah, Georgia on the morning of the third day after leaving New York. Ordinary rail movement requires 9 days.

The time required for ordinary rail movement from Chicago to New York is 14 days. A rail trailer express train makes it overnight. These figures sound almost incredible, but I am assured on reliable authority that they are accurate. I'll leave the inferences up to you.

Many other containers, some designed to function with a system of special railroad cars, are currently being used or developed. Worthy of mention is the collapsible rubber drum now being used for transportation and storage of bulk and liquid materials such as carbon black, shellac, and similar hard-to-handle materials. These come in 500 and 2500 gallon capacities, and can be loaded on barges or gondola cars for shipment over long distances. There is some talk about towing filled units behind tugboats on inland waters. Again,

these units would seem to have some military potential.

But you can see what these container systems are leading to, gentlemen: we are going to "can" many of our products for distribution and storage. The king-sized container for both military and commercial use has too much to offer for us to pass it by -- not the least of which is more fluid, mobile, and lower cost distribution and storage.

You may be thinking that even these large sized containers must be handled as units, and therefore do not represent the ideal solution for many bulk materials -- and I would agree with you heartily. The ideal method of handling would be by pipeline or overland conveyor. If we can pump oil thousands of miles, there is no reason why we cannot fluidize solids and do the same thing with them -- or why we cannot transport them overland by belt conveyor. Although the Riverlake Project still is bogged down in the Ohio Legislature, its backers are hopeful that next year it will receive recognition as a common carrier. The backers of this project, as you probably know, plan to invest more that $200,000,000 in the construction of a 100-mile belt conveyor system connecting the Great Lakes and the Ohio River. The two-way system will be used to transport an estimated 7 to 15 million tons of coal annually from East Liverpool to Cleveland via Youngstown, and some 20 million tons of iron ore in the other direction.

But while this project is currently held up, considerable progress is being made on another that is equally significant: this is the Pittsburgh Consolidated Coal Company's 108 mile pipeline for coal. It is expected to be ready for operation by the end of 1956, and will deliver approximately 18 million tons of coal to the Eastlake Station of Cleveland Electric Illuminating Company in greater Cleveland from Pitt-Consul's preparation plant near Cadiz, Ohio.

A contract for the delivery of the coal over a 15-year period was signed recently by the two firms. The coal, to enter the line crushed and mixed with water, will be transported in the form of a slurı . It will be propelled by three pumps through the 10-3/4 in. line at the rate of about three to four miles an hour. At the receiving end the coal will be dewatered by the customer, Cleveland Electric Illuminating.

Pitt-Consul reached its decision on the commercialization of a coal-carrying pipeline system only after accumulating and evaluating data from its experimental pipeline project which was operated for the better part of a year. The project simulated a commercial operation both as to equipment and conditions of topography. It employed a 12-3/4-in. diameter pipe about 17,000-ft. long through which from 7000 to 9000 tons of coal were moved daily. Fine sizes of coal were mixed with water to form a slurry which was pumped through the pipeline under pressure.

This full-scale demonstration was built at a cost of about $550,000 by Pitt-Consul's Research and Development Division which has been making studies of work done on the movement of coal by pipelines by other companies here and abroad over the past 50 years.

The 108-mile pipeline is being constructed with the cooperation of the two railroads serving the mine and the one railroad upon which the utility plant is located. The New York Central Railroad, the New York, Chicago and St. Louis Railroad, and the Pennsylvania Railroad are participating with the coal company. These railroads are in a position to take substantial ownership in this project when construction is completed.

So here is the ultimate in distribution, gentlemen: no handling at all.

There is only one missing element in the cycle that I have tried to paint for you today, and I would like to comment on that briefly before closing -- even though its connection with materials handling may be somewhat obscure. This is the subject of communications and processing of orders.

With new electronic processing equipment and faster means of communications, we can cut our lead time on orders ... find out within a matter of seconds what our inventories are and where they are located ... and keep in closer contact with field offices, branch plants, and divisions. Such developments as closed circuit television that can be transmitted over 10 - 15 KC standard telephone lines instead of 4 MC coaxial cables -- reading machines that can actually read an order, duplicate any number of copies that are needed, and transmit the data by wire or microwave -- and low cost

electronic computers -- are bound to reduce much of the handling and rehandling we now do.

Let me sum up very briefly, gentlemen. The developments that I have touched upon today -- and many, many others such as new narrow aisle stackers, railroad cars with overhead doors along the side so that the entire side of the car can be opened up, palletless handling, electronic classification yards for freight, the use of the airplane for mass transport -- all point to one fact: that within the next few years there will be a revolution in military and industrial distribution. The only thing that could prevent it would be that we did not foresee the need for new techniques and equipment. I have a friend who had a friend named Scudney who sells books in Maine. This man was fabulously successful. He seemed to have an answer for every objection that a prospective customer could raise. My friend was fascinated by his approach and said to Scudney one day: "Scudney, is there anything that a prospect can say to you that you don't have an answer for? Is there any way to stop you cold?"

Scudney replied: "Just one thing. He can say, "I can't see".

There's no danger of "not seeing" in the materials handling and packaging field. Because of men like you, who can not only see but anticipate our needs, I have no qualms about our rate of progress. I am certain that it will be not only fast -- but breathtaking.

Tuesday PM Oct. 11, 1955

Automatic Packaging of Military Supplies

Mr. Roger Putnam
President, Package Machinery Company

I don't think you need the story I was going to begin with, but I will tell you anyhow about the man who settled out on an Omaha farm. It wasn't really a farm. It was some wild land he was trying to make into a farm and he found that it was more work clearing it than he had thought. He just couldn't do it alone. He needed some kind of help. He heard of a farmer down the road who had a mule he thought he could buy and he thought it was just the help he needed. He went down to talk to the farmer about the mule and the farmer said, why, sure, it was a wonderful mule, just what he wanted, quiet, gentle, obedient, never had to be harsh with her, just had to talk to her a little and she'd do anything you want.

The man said, "Let's see the mule. Let's see how this happens." So the mule was up there and the farmer whispered in her ear, "Now, honey, show this man what you can do. You know, honey, stay perfectly still, not wiggle an ear or muscle." Now, he whispered again, "Now, honey, I told him how gentle you were and how nice to do something." So he picked up a log of wood that was there and hit her over her head and the other man said, "I thought you didn't have to do anything but talk to her." The farmer said, "You don't but first you have to get her attention."

(Laughter.)

So, having got your attention, I can go on from there.

Now, there is nobody that can be actually an expert in package machinery. I think maybe one of the editors of our papers might do as good a job as Mr. Laughner did about materials handling but I don't pretend to be able to. I have, as Mr. Postweiler told you, made my living out of packaging machinery most of the time since I got out of the Navy in World War I, which was almost 37 years ago.

I was one of the organizers of the Package Machinery Institute way back when, but I am not an officer of that now. I am just perhaps one of the elder statesmen. Perhaps that is why they picked me out to come down here to talk to you, but I believe it is on their account that I am here.

Now, it is probably hard for anyone outside of the packaging industry to have any idea how broad it really is. The

Packaging Machine Manufacturers Institute has about 70 different members and yet practically no one of those members has more than about four or five competitors. It is that we're all a bunch of specialists and yet there are some 70-odd members of the Institute.

I have here and I hope that some of you have them -- they are certainly available -- the official directory of the Packaging Machinery Manufacturers Institute. It has about 250 different classifications of types of machines that are made by the industry. They go all the way from "handful filling" near the A end of the alphabet down to "wrapping, tight" close to the Z end of the alphabet, and they cover in the large section here every sort of kind of machinery from handling bags and bottles and boxes to cans and capsules and cartons and cases, and many other things in between. It is possible that some machines are handled twice as "bottle labeler" and "labler for bottles" but I counted over 250 different kinds of machinery listed as made by the packaging machinery manufacturers.

I am sure a lot of you do have this book. I hope you do and it will help you find your way around and know whom to ask for for information about machinery. And, of course, the packaging machinery manufacturers have an office in New York, the Institute has, and they always will be ready to help any of you and tell you who does make the kind of machinery you want if it is made at all or who comes nearest to it, and I am not going to take the time here to be a catalog for you of the different kinds of machinery made. Suffice it to say if it is the kind of machinery you can use it saves an awful lot of money. And I will leave it at that except that I will allude to it from time to time during this talk.

But I want, as Mr. Laughner did, to look at the forest rather than the trees. The catalog with the trees you can all have and, as I said, they run from -- the whole gamut -- from semi-automatic machinery where you do the more difficult parts or touch the easier parts by hand and difficult parts by machine to high-speed never-stop machines that will form cartons, fill them with sugar or flour at something like 300 or 400 a minute and every other sort of package in-between at varying kinds of speeds.

We can fit into most of what you -- not necessarily what you do want but perhaps what you think you ought to.

I also have a little knowledge of military packaging from the back end because, in addition to starting off in research and development in the Amphibious Forces, I ended up with a system on Admiral Kirk's staff, who was handling our naval forces in the Normandy invasion, and I spent a good deal of time in our naval bases along the south coast that were being so ably run by Admiral Welch, the support bases for all the landing craft.

I saw a good deal of the handling of spare parts and problems to do with this. I have eaten K rations and C rations and, of course, when I was in England -- any of you who were with the Navy in that part of the world know what I mean when I say I spent as many nights as I could when I was traveling around to somehow see if I could possibly spend a night at our Naval Depot in Exeter. If you don't know what the reason was, that was the only place in England where you could get cold American beer and you could get it there and they were very liberal with it to visiting officers. Exeter was a very pleasant place to stop at.

The Naval Supply Corps did very well for the rest of the Navy when they came by and even let some of the other armed services stop there too. But I got some little idea of how the supply services really worked when you are away from home too. I mean, for instance, in our own rather small military establishment, we didn't have a great many people but did need some things and the know-how to get them and get them well.

We had a first-class storekeeper we promoted to chief because we discovered -- I am sure we were right -- he was the best thief in uniform. An example of how he worked when we moved down to Plymouth a month before the invasion started: We found ourselves not far away from a Quartermaster establishment and this chief storekeeper of ours noticed they didn't have too many guards in the Quartermaster establishment. He wasn't going to go and sneak in behind the guards when the guards weren't looking. He went down to the commanding officer, a poor, harassed major, of this Quartermaster Supply Depot, and said he noticed an awfully few guards and the major agreed and this man wanted to lend him some of our people for guard duty. (Laughter.) We seemed to acquire a lot of the Quartermaster supplies anyhow, somehow or other.

I was off from Omaha Beach after D-plus-four. I don't want to try to have you think of me as anybody that was out there braving the bullets. I was just sitting on the flagship in a grandstand sea ut after D-plus-four anyway I was sure

a lot on Omaha Beach and I saw a good deal of what happens to military stores in that kind of operation.

Again, I don't qualify as an expert and I certainly shouldn't talk to any of you as an expert on military packaging but I definitely am not, but like any other proper American who served in the war I came back full of admiration for the broad planning that was done and full of admiration for the individual Americans who actually did it and full of gripes about the little things that we all saw. We all came back very good Monday morning quarterbacks that knew how we would have done the job a great deal better, at least in the little things.

I think all Americans who served in any combat area came back with that same feeling of general admiration and individual gripes.

Now, having waved this black book at you that I did, I don't think I have to tell any of you the advantages of using automatic machinery in packaging. As a businessman I know that business has to use such machines to survive and as a former government employee I know what it is to have budgets to work under and how very important it is to save money in any government establishment, because what your budget is fixed at and what you can save is what you can get something else with, and that comes down as a very vital thing for the survival or increase and proper functioning of the things that you have to do.

It may be necessary in wartime to save this labor just to exist at all because it isn't money that we're talking about saving. It is scarce labor and often scarce material, and I am sure I don't have to tell you the need of using automatic machinery if it is possible in the packaging operation, not so much that you do but order it done in the specification in which you order material to come to you.

Even more fundamentally we know in wartime there is a limit all the way through to the manpower and the materials available and you must take advantage of every possible mechanical means of saving that manpower and those materials. After all, what we're planning for, all of us, is a possible war. That is why we are all here. God forbid it should happen but if we knew for certain such a thing never would happen we would not one of us be here. Even if today's needs don't warrant automatic packaging wartime needs will and, therefore, it seems to me vital to design packages now so they can be handled automatically when the pinch comes when

we need it. But when war arrives it is too late then to start designing special machines. It takes too long and, believe me, from having been on the other end, packaging machines are way down the list of priorities when it comes to getting steel or much more scarce engineering manpower.

Now, you wouldn't be here if you didn't feel the same way I do about all this, so perhaps I shouldn't labor the point, but it is essential that military packaging which will run into any large volume should be adapted to existing machinery or even now, in peacetime, machinery should be developed if it is not available.

It may help a little on this to see one of the fundamental differences between civilian and military packaging. I am not talking primarily about big things like refrigerators. You may not in wartime need to procure them in enough quantities so that they will have to find an automatic way of being packaged as Mr. Laughner said, but I am thinking of the much smaller units that are used in really large quantities. That is where I am thinking of automatic machinery, the kind of things that you want to have done at a hundred a minute or more.

Now, I don't think that the difference between the civilian packagers' need and the military packagers' needs are quite as great as most people think. The civilian packager is, if possible, more interested in having his package arrive at its destination with its contents perfect than is the military. The civilian packager is up against competition for the user's preference. If your wife finds that the crackers from Manufacturer A arrive crisper than those of Manufacturer B she keeps on buying A's crackers and B goes out of business. B's crackers may still be perfectly usable but if they are not better than A's he is out.

Now, for you in the military, however, the only thing that is essential is that the package arrive properly serviceable. They don't necessarily have to be A-1 perfect. If I am eating K rations I don't always expect the crackers in them to be as perfect as I used to get them at home. I may even be thankful if they are not moldy. I grant you the better they are the better for my morale, but I am not going to starve if the crackers are edible and I am not going to desert to the enemy because his crackers are crisper.

Good military packaging is essential, however, because the crackers <u>must</u> be serviceable and I underline that word "must" with all the power at my command. Military packaging must get

the product at the point of use in usable form or every bit of t[illegible] scarce procurement, scarce transportation and scarce time in war was wasted in getting it there. So it must be serviceable but it doesn't have to have the competition of A-1 perfection that the civilian man is up against every day of his life.

There is, nevertheless, lots in common between civilian and military packaging. Civilian packaging aims at perfection through a shorter period of more careful handling. Military packaging must exceed in serviceability over a much longer period with much more difficult handling. But don't short-change the civilian, nevertheless, in your estimation. He wants good packaging too and it is for him that the present packaging machines are built. They must be because he is the only one who is really willing to pay for them in a quantity enough to make the development of them worth-while.

Now, you who ha[illegible]e to do with military procurement, I know, have similar ideas of what it costs to develop special machinery and I thin[illegible] [illegible]ou also have some idea of how long it takes. None of [illegible] s machinery business can afford to develop special m[illegible]es unless enough of them are going to be built so our fa[illegible]ories can make a profit. We don't make a profit in our engineering department. We make a profit in our factories and we must put our designers, our engineers, etc., to work on things that will keep our factories busy.

There is practically no figure at which any of us really enjoys making a special machine. If you wanted one of our best designers in my own company to do a job for you and offered us twice what we pay him we wouldn't even listen to you. The overhead and the supervision would eat all that up and our shop would be empty next year because he had not been designing things for that. If you will pay us four times what we pay him, it still wouldn't be worth-while for us. We need to keep him designing those things that are going to keep our whole business operating, employing our machinists, our assemblers and our testers. I don't mean from this that the industry is stuffy. At least, I don't mean to infer that we're not anxious to help but I am trying to point out to you what it costs the machinery manufacturer in loss of civilian work, in loss of livelihood, whenever our designing abilities are sidetracked from those things that will give our factories work.

When that is all over and above the ordinary cost of making something special, the experimentings, the testing, the going through a prototype -- that is an additional part of the cost over and above the cost of tying up the engineers that I spoke of.

I really believe it is harder and just as costly and time-consuming to try to make serious alterations in packaging machinery as it is tomake serious alterations in military specifications and I don't think that is easy either.

Now, I will come back to both these subjects a little later but I have one other that I want to give you and I know it will be received without too much enthusiasm by some of you, so I'll tell you what I am going to do when I get through, when I have provoked you enough. Just save your wrath until tomorrow because I promise to come back and I will be in Bill Bronander's session in Room 4829 tomorrow morning and you can come back with all the bullets and eggs or whatever you want and I will be there. So if I provoke you now, you can have a crack at me tomorrow.

Now, I want to point out to you the need for protection in the individual packages depends tremendously on the care with which that package is transported and stored. I wish I'd been here yesterday to have heard the talks about unit containers and Mr. Laughner touched on them just now because it is just in line with the kind of thing I am talking about now, so if I repeat a little bit or if my fire has been taken away from me, forgive me but I won't be long at it.

In other words, there is a third variable in the product. There is the need for protection up to the point of use. There is the need for packing automatically but there is a third need and that is for getting the article to the point of use intact. It may well be cheaper in some cases to spend more money on care and handling and possibly even warehousing at the point of use than it is to take that same care in protecting each individual package and that I understand you have touched on and I am delighted you have.

Of course, I know I am treading on dangerous ground on this subject, but I happen to be a little in touch with it both ways. My company has been making some substantial units for the Navy and the orders for the units are always accompanied by a large number of units for spares. These spare parts, I don't have to tell you, have packaging specifications on them that often entail more cost in packaging than they do in making the product, so much so that we don't attempt to do it ourselves. We get a contract packager to do it and he charges us plenty and we charge the Navy accordingly.

Now, as I told you in the beginning, I have been on some invasion beaches and I know what happens to spare parts unless there is a storekeeper to take care of them and if there is a

storekeeper perhaps he can have a Quonset hut for his stores or some little shelter. If it is for shipboard use, as the stores I am talking about now are, then it is generally possible to store things aboard shipboard just as warm and as snug and dry as it is in most warehouses on land, and, really, parts don't have to be any better protected than, for instance, our automobile parts which are going to be used on land and they must get to their user in satisfactory condition too. They are packaged, to be sure, but much more simply than the Navy asks their parts to be packaged. They are kept in dry warehouses but I don't think any drier than most naval ships I have been on, and I have been on various ones at different times.

In fact, when I decided which service I would go in in World War I, I picked the Navy because that is the service in which you keep dry.

Now, I am certainly out of order to try to lecture you on military specifications but I don't think they are much different than any other governmental regulation. I have never had anything to do with preparing military specifications but I have had a lot to do with preparing other government regulations and the lawyer is hired, or probably several of them, to think of every possible contingency when he draws up an agreement or government specification, and he puts in so many words that frequently they aren't understood, and a government specification is the same kind of thing.

We have to think up every possible contingency and try to make sure we protect against it. This is natural, but it can be very, very costly if it prevents our doing things in an automatic way they are done in civilian life. We don't try to put the same package around our boys when they are going to the tropics as we do when they are going to the Arctic. We don't make them wear the same uniforms in winter as we do in summer and it is possible we're trying to make specifications like an all purpose uniform that is as good in the tropics as it is up in Thule.

I truly believe that military specifications need a new look, just as I truly believe that we in the packaging industry must look with you at what you need so as to come as close to it as we possibly can within the limits of our ability.

So, now having made these critical remarks, I want to come to a very concrete suggestion. I would like very much to suggest that you as military packagers and we as packaging machinery men try to find the compromise between us.

That is a very good American way of solving problems. We can never all have all our own way all the time, whether it be in government or whether it be at home. We have progressed as a nation to the position that we have in the world because we are able to see the essentials and because we have always been willing to compromise on the least essential parts.

The packaging machinery industry wants to help you to cut costs. We want to help you because, after all, we pay taxes too, but more than that, we're Americans ourselves and we want our country strong in case of war just as much as anybody else does and you are just as interested in cutting costs as we possibly could be to have you and you are just as interested in having the country strong as we could possibly be, so I say let's see how we can work together to make our machines do good jobs for you.

My suggestion is that if the armed services, all of them jointly — and I mean all of them jointly — would appoint a central packaging committee to look into the possibility of machine use and the possibility of modifying specifications. I knc that the packaging machinery manufacturers and the Institute would be delighted to appoint a committee to work with it.

I have every reason to believe that the makers of materials, the flexible Packaging Institute, would be delighted to appoint a similar committee.

Now, these three committees, working together, I personally believe, could do a tremendous amount of good for our country. Work such as theirs is not going to come easy, however. The machinery manufacturer, as I have already pointed out, will find it costly to make changes and, therefore, being American businessmen, they will be reluctant.

I am sure that the Committee you appoint and the people you represent will be reluctant to change the specifications that you have worked, many of you, very, very hard to produce but it could turn out the savings will be worth the risks involved. At least I note the kind of committee we all would appoint would come together with an open mind because we're all searching for the same goal, that treasure hidden in the pile we're searching through would be a treasure to all of us and we would all be equally anxious to find it.

Certainly such committees working together will accomplish another good. Perhaps we're each inclined to be a little suspicious of the other at the moment and I am sure I haven't

said anything to make you unsuspicious of me. I have been quite critical, so you have a right to be suspicious of me because I have already said some things but I know and you know from things I have said I am skeptical about some of your military specifications. I thought they were tighter than they need to be and I suspect many of you think of us in the machinery business the way the public felt about Henry Ford some 25 years ago when he said they could have any color they wanted as long as it was black. But, by getting together, sitting around a table, getting to know one another, I think we will lose that suspicion that is almost inevitable that we now have.

When you lose your suspicion of another person you find it quite easy to work together and I believe there is enough in there to make it worth-while.

In conclusion, therefore, let me say this: I think the time has come when we need an organized cooperative effort. Each one of you individuals, I am sure, has talked to certain machinery manufacturers individually, but I think we now need an organized effort to recognize committees of both groups that will have power -- if not to make decisions, then to at least make recommendations to the top personnel that would have real weight.

I think that is a most valuable idea but I would also like to point out that packaging alone is not the answer to survival.

Warehousing at home, shipping and care at the point of use are important variables in the whole program in getting things where they are wanted in proper condition. There may be times or cases where care in transportation will more than warrant its expense by the savings in the package. I know I speak for the Packaging Machinery Manufacturers Institute, although I am no longer an officer of it, when I say to you that we stand ready to work with you to search out the ways in which we can all together be most helpful to our country.

Tuesday PM Oct. 11, 1955

The Joint Military Packaging Course

Captain James R. Glisson, USA
Commandant, Joint Military Packaging Course

It is my privilege to present to you, gentlemen, information concerning the Joint Military Packaging Course and, under the Department of Defense policy to invite you to participate in this training program. Some of you have enrolled personnel in our Course. You have told us that it was of substantial benefit in solving problems related to packaging for the military. Many of you may not be aware that this service is available to industry. The people who are responsible for the agenda of this meeting, therefore, have allotted time for me to acquaint you with the training program and its application to industry.

MISSION:

The Joint Military Packaging Course has the mission of training selected military personnel, civilian government employees, and representatives of industry in the basic principlesand correct application of procedures concerning packaging and packing for and by the military, as established by current specifications and directives.

PREREQUISITES FOR ENROLLMENT OF PERSONNEL FROM INDUSTRY:

Industrial firms which have a current military packaging contract or sub-contract are encouraged to enroll appropriate packaging personnel in the Joint Military Packaging Course. Since the Course is conducted at the supervisory level, industrial firms will profit most from the Course by sending representatives who have management or supervisory responsibilities relative to packaging.

LENGTH OF COURSE:

The complete Course is divided into two phases:

Phase I - Preservation and Packaging, is of two weeks duration and covers 76 hours of instruction.

Phase II - Packing, Carloading and Similar Approved Subjects, is of two weeks duration and covers 76 hours of instruction.

Representatives from industry may attend either Phase I or Phase II independent of each other or both consecutively.

Capt. J. R. Glisson, USA Tuesday PM Oct. 11, 1955

CURRICULUM:

Phase I - Preservation and Packaging - consists basically of the following subjects: packaging specifications, cleaning and drying, preservatives and their applications, methods of unit protection, dehumidification, volatile corrosion inhibitors, cocooning, economy in packaging, and packaging inspection.

Phase II - Packing, Carloading and Similar Approved Subjects - includes information concerning the most commonly used containers such as: crates, wirebounds, fiberboards, nailed wood boxes, metal and other special purpose containers, blocking, bracing and cushioning, marking, preparation of freight for air shipment, economy in packing, carloading, and packing inspection.

SCHEDULES:

The school is operated on a continuing basis with a new class in Phase I and Phase II convening every Monday. Exceptions to this rule are found in a pamphlet of student information which can be obtained from the school upon request. Spaces will be given on, or as near the requested starting date as possible.

HISTORY OF THE JOINT MILITARY PACKAGING COURSE:

The Joint Military Packaging Course began operation at Rossford Ordnance Depot, Toledo, Ohio, on 17 September 1951, when the Secretary of Defense issued a directive re-designating the Ordnance Packaging Training Course as the Joint Military Packaging Course. The Ordnance Packaging Training Course had operated for nearly one (1) year, having had its initial session on 2 October 1950.

To meet the training requirements of the various Technical Services of the Army, Departments of the Navy and the Air Force, the scope of the course was enlarged and the necessary adjustments in the training program made. The training staff had the benefit of the assistance of representatives from the Forest Products Laboratory in both preparation of course material and actual classroom instruction during the first year of operation. Many well qualified packaging personnel from the various Department of Defense establishments also provided pertinent advice. Industry made substantial contributions to the Course in establishing it and has continued to provide assistance whenever requested.

2 of [illegible]

In this fiscal year of 1956, other major changes are being put into effect. Phase I has been redesignated as Preservation and Packaging, and Phase II has been redesignated as Packing, Carloading, and Other Similar Approved Subjects. New subjects have been added to the curriculum of both phases in order to keep pace with the more recent packaging trends and developments. Closer co-ordination among the military departments and with industry has been achieved and numerous facilities have been added to increase instructional efficiency.

DEPARTMENT OF DEFENSE SPONSORSHIP OF PARTICIPATION BY INDUSTRY IN JOINT MILITARY PACKAGING COURSE:

From its inception, the Joint Military Packaging Course was not limited to the training of military personnel or government employees only. Provision was made by the Secretary of Defense to include private industries that have packaging contracts or sub-contracts for the government.

PARTICIPATION OF INDUSTRY IN THE JOINT MILITARY PACKAGING COURSE:

Up to 15 September 1955, 634 representatives of industrial firms have been trained at the Joint Military Packaging Course. The number of companies also reaches into the hundreds and includes a good cross-section of American industry including such well known concerns asGeneral Motors, Westinghouse, DuPont de Nemours, Douglas Aircraft Corporation, Goodyear, General Mills, and many others.

PROCEDURE FOR INDUSTRY TO ATTEND:

Application for attendance is accomplished by sending a letter addressed to the Commanding Officer, Rossford Ordnance Depot, Toledo 1, Ohio, ATTENTION: Joint Military Packaging Course. Such a letter must contain a current packaging contract or sub-contract number awarded by one of the Military Services, the name(s) of the prospective student(s) with their job description(s), the information regarding the Phase or Phases to be attended, and the approximate date when enrollment is desired. The Course is made available to qualified industrial concerns on a tuition free basis.

STUDENT INFORMATION BOOKLET:

For further information, the Joint Military Packaging Course has prepared an information booklet which covers in detail the requirements for enrollment, prerequisites for

entrance, the curriculum for Phases I and II, the schedule for the fiscal year of 1956, and general information of value to management in making selections and to the student prior to his arrival at the Joint Military Packaging Course.

Tuesday PM Oct. 11, 1955

"An Approach to the Selection of Packaging Methods"

Mr. Paul F. Curtis
Air Materiel Command, Wright-Patterson Air Force Base, Ohio

The Air Materiel Command is the buyer, directly or indirectly, of all supplies for the United States Air Force. Since every item bought must in one form or another be packaged, there is within the Air Materiel Command the Packaging & Materials Handling Division, of which I am a representative, that has the responsibility for the packaging called out on all procurements.

We are the managers of Air Force packaging, and our responsibility is simply this - to make certain that every item packaged for the Air Force arrives at its ultimate destination fit for immediate use.

When I tell you that the Air Force stocks and issues over one million items, you will realize the enormity of our packaging problem. In a job of this size, the possibility of error, whether of omission or commission is tremendous, and I admit we have made our fair share of mistakes. I should imagine that those of you who at one time or another have had contracts with the Air Force were possibly annoyed at our packaging requirements - considered them irksome, perhaps considered them unnecessary, or perhaps even could justifiably accuse us of over-protecting Air Force material. We recognized our problem, and the solution is the subject of my speech today, which is "Approach to Selection of Packaging Methods". Without going into it too deeply at this point, it is a system insuring standardization of methods by utilizing a Preservation Selection Chart and reflecting the packaging requirements by a code for items we buy from you and store and issue from our depots.

I would like to tell you of the problems we faced which forced us into using this (coding) system. Let me outline those problems.

1. This has been said before, but it is worth repeating. We are responsible for the packaging instructions for over one million items in Air Force supply. Incidentally, gentlemen, this number is not static, but rather is extremely dynamic because of the rapid obsolescence of aircraft and its components.

2. We have a personnel problem. There has always been a shortage of properly trained packaging technicians, both in industry and in the services, and the Air Force has been no exception. We have tried to train people, but a period of training is long, generally running well over a year before you could trust a man to properly work with a contractor in the packaging of some of the extremely valuable things we buy for the Air Force. This shortage of packaging personnel was further aggravated by duplication of efforts, and the packaging technician

being required to do what clerks could have done had the detail packaging data pertinent to each item been available.

3. Due to the tremendous number of items requiring packaging instructions and our shortage of trained personnel, we were unable to maintain a complete and accurate set of records. Therefore, frequently in a new procurement a new packaging problem was raised for the technician. He had inadequate records to rely on and therefore solved the problem as best he could. The obvious fallacy of this method is that no matter how able the technician, he was frequently packaging an item he had never seen, and the possibility of over or under-packaging was always present.

4. We attempted to solve our problem of inadequate records by sending packaging teams to the contractors plant. During this visit the contractor and the technician would look at the item itself and call out the packaging on-the-spot. The contractor would then maintain a card file on each item and the packaging prescribed for it so that in future procurements, we could be assured of identical packaging. But even with this system, we found that at best, we had cards on less than 40% of the items we are buying. Another objection was the fact that 2 technicians on separate visits to 2 different contractors, or even 2 different plants of the same contractor, might package the same item in a different way.

5. We had no records which told us how much the item weighed or how large it was. We never were able to tell in advance what a given shipment might weigh and cube - how many rail cars, or planes, or bottoms we might need.

6. Our last problem was in our contractor relationships. Frequently, our packaging instructions were ambiguous and the hapless contractor found himself at odds with the Quality Control Inspector when it came to interpreting the packaging instructions or specifications.

With these problems before us we realized that to go on was leading us no where; in fact, we were falling further and further behind. We made a thorough study of our packaging procedures and what could be done to improve them. We probed into numerous possible solutions and eventually decided on the following:

1. Establish a system of developing and recording data about each item through the use of an 8 digit code that would combine weight and cubage with the standardized packaging information. This packaging information to be in such a form as to lend itself to the electrical recording machines used in the cataloging of Air Force supplies.

2. Develop some medium that would insure the selection of the same method of preservation for items made of the same material and having the same characteristics, regardless of source, use, or nomenclature.

To accomplish this, we physically examined some six hundred thousand items and found that they could be separated into 72 groups, or families, which could be covered by the same number of individual packaging instructions. There are 3 major groupings into which all of these items fall.

1. Electrical, including electrical instruments.

2. Non-electrical instruments or other assemblies having critical internal parts.

3. All other.

Within these 3 major groupings we have further detail, such as sealed instruments or those not sealed, type of material, plating, painted surfaces, critical versus non-critical surfaces, high or low tolerance, etc. This breakdown also includes non-metallic items which require protection.

Each family is numbered from 1 to 72 which becomes the first 2 digits of the code and defines the method of preservation. The next step was to determine the unit pack quantity for the item, which is spelled out by the third symbol in the code.

The fourth symbol indicates the physical protection required by the item, over and above the protection provided by the method of preservation. For example, additional protection against abrasion may require over-wrapping in a single faced corrugated fiberboard or cushioning material. We use approximately 22 different methods to provide this additional protection. The 5th and 6th symbols of the code indicate the gross weight, and the 7th and 8th symbols indicate the gross cube of the unit package.

To the packaging technician, the code provides information on the proper method of preservation, unit pack quantity, additional wrapping required, and the weight and cube of the item. On the other hand, the contractor, by decoding against a manual supplied to him by the Air Force, will know exactly and in detail what is expected of him.

Now let us take an example. I have selected a Side Gunner Safety Harness Assembly made up of cotton webbing, a cadmium plated steel buckle, and a leather protector. This item is coded 50ABACAG.

The first two symbols, "50", represent the page number in the preservation instruction manual. This instruction defines the protection required for items made of this combination of materials and spells out the details.

The third symbol, "A", means the unit pack quantity is one each.

The fourth symbol, "B", indicates the physical protection required by the item which, in this instance, is a folding carton, set-up box, fiberboard box, or a similar approved container.

The fifth and sixth symbols, "AC", means the finished pack shall not weigh more than 1.99 pounds.

The seventh and eighth symbol "AG" mean the finished pack shall not exceed 149.99 cubic inches.

An interesting sidelight on the research into weights is that over 73% of the items we checked weighed less than 1 lb., and that 92% weighed under 5 lbs.

These items which lend themselves to family grouping and packaging under 72 instructions represent approximately 80% of the total. The balance represents large, bulky, intricate items which require special blocking, bracing, and cushioning to insure proper protection. This will be done by the use of the detail commodity specification, general packaging specifications, or by development of additional individual instructions. The code will still be used to specivy the unit pack quantity, gross weight, and cube of the pack.

Now a word about the progress that has been made in coding Air Force equipment and spares. Catalog supplements already have been printed for 85% of the property classes, and the remainder will be in print by the end of October. New items coming into the supply system each month are coded for subsequent publication as "changes" to the catalog supplement. Before too long a time, the eight digit code with its decoding manual will become part of Air Force procurement documents.

What does it mean to industry and to the Air Force? Here are the advantages we expect to derive from this coding system.

1. We will have the same method of packaging for all items having the same characteristics, regardless of which airplane, weapon, or gadget it is used on.

2. There will no longer be the need for trained packaging people in the depots to spell out detailed packaging on Purchase Requests. This work can be done by clerical people with the packaging technician devoting his time to the more important engineering aspects of his responsibilities.

3. The data developed will be available to all of our depots instead of being localized within the prime property class depot, as has been true in the past.

4. The advent of a better method of preservation - magnesium for example - can be reflected quickly in all items made of magnesium by machine sorting all cards carrying that family coding.

Air Force contractors too, will benefit from these new procedures.

1. The use of the Preservation Selection Chart will greatly reduce the time required to determine proper packaging methods.

2. The need for changes in packaging presently being requested by depots during the process of coordination is eliminated. It is planned in the near future to accept and approve preservation and packaging details at the prime contractors' plant for all new items coming into the supply system. The depot prime for the contract will represent and commit all other AMC depots which are prime for components and spares.

3. They allow better utilization of all contractors' packaging facilities because of the flexibility provided in the various packaging group instructions.

4. The number of copies of reproduced ANA-PT Cards presently supplied our depots by contractors is reduced.

5. Standardized identical packaging requirements in follow-on contracts and purchase orders are assured.

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Reducing Transportation and Handling Costs

Cdr. T. S. Stern SC, USN
Director, Storage Division, Bureau of Supplies and Accounts, Navy

An essential element of any policy for the defense of the United States is the ability to apply military power where and when required. To make this possible the American public has a vast investment of tax dollars in the military departments.

Our problem is that dollar - to stretch it to its very limits and to diligently strive in every way to get the most out of it in weapons, material and personnel.

Faced with rising costs of transportation and constant demands for increased utilization of existing transportation facilities, the military services have focused the "management spotlight" on the need for reducing transportation and related handling costs.

Since transportation services are charged for on the basis of weight and displacement, the spotlight quickly illuminates the size and weight of packages and shipping containers.

The problem of excess tare weight and cube has been a matter of concern to both you in industry and we of the military for many years.

It is estimated that about 60 percent of the tonnage dollar expended for the shipment of material to, from, or between activities of the Department of the Defense involves material that requires some form of packaging for protection against damage in shipment and handling or for facilitating warehousing and related handling operations.

During the past several years - through detailed studies - the services have demonstrated to their satisfaction that it is possible to achieve significant transportation economies by reducing, controlling or restricting the weight and size of packages and shipping containers <u>without</u> sacrificing <u>requirements for protection</u>.

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As a result, we have formaliz.d within the Department of Defense a "military study" which provides the framework for collaboration between the services to develop uniform criteria and thus encourage "maximum practicable effort" in this area.

What is the scope of our program? The effort to reduce tare weight and cube is applicable to all shipments to, from, or between activities of the Department of Defense whether prepared by industry or the military establishment. The over-all objectives are not confined to any specific means of transportation.

And, what are these objectives? First, to promote the use of the lightest weight packaging materials suited to the characteristics of supplies - consistent with the need for the protection of such items during handling, storage and transportation.

Next - to restrict to the maximum practicable extent, the size of articles, packages and individual shipping containers in order to keep space occupied during storage and shipment to an absolute minimum. And, to effect transportation and other shipping economies in the handling of military materials by making the most profitable use of transportation space, facilities and practices.

In fostering these objectives, the services emphasize that it is the intent of this effort to effect economies without sacrificing requirements for protection.

It is obviously false economy to sacrifice the material itself in an overzealous attempt to reduce costs for packing and transportation. We have found, however, that numerous items may be afforded greater protection in lightweight packs with new interior designs than in old style, heavy shipping containers.

In carrying out these objectives, the services recognize that studies to reduce weight and cube are of a "continuing nature" because of constant and continuing changes in the physical and mechanical characteristics of military supplies and equipment, because of changes in supply distribution patterns and improvements in packaging materials, methods and equipment; and, not to be overlooked - changes in materials handling methods and carrier facilities which influence requirements for protection.

In order to provide a uniformity in purpose between the services, there are numerous specific areas which we find provide a basis for mutual understanding.

For example, objectives of the "Military Study for the Reduction of Tare Weight and Cube" do not alter existing Department of Defense packaging policy, and

The problem of excess tare weight and cube is especially critical in the movement of cargo by air due to a combination of configuration limits and relatively high costs.

As to new procurement, a large majority of the materials shipped by military activities utilize containers in which the material was originally received from contractors. In many instances, the weight and cube of such containers can be substantially reduced without sacrificing protection.

When contractor shipments include excessive tare weight, the cost of transportation involved in the movement from the contractor to the first point of entrance into the Supply System is excessive and it is possible too that the packing cost is likewise excessive.

The reduction of tare weight after material is in the Supply System - in order to effect future savings in transportation costs - involves repacking expense together with attendant delays and additional handling.

Reductions in weight and size are often achieved through "repacking" or "unpacking". It is, therefore, necessary to stress that "repacking" or "unpacking" of materials prepared to precise specifications should not be undertaken without prior approval of the cognizant technical authority.

A point that I must stress is that continued emphasis on reducing tare weight does not mean the elimination of wood containers as shipping containers. Wood in itself, when properly dried, cut and fabricated, affords excellent opportunities for savings in tare weight and we are taking every advantage of this fact.

Based on the experience and studies mentioned previously, it has been concluded that worthwhile economies, both tangible and intangible, can be realized from aggressive exploitation of the following concepts and principles, all of which are based on the premise of delivering supplies to consumers in usable condition.

1. The establishment of break-even points for shipment by various modes of transportation and to repack when break-even costs warrant. (A break-even point is defined as "the point at which total costs incurred in making a change in packaging equals the benefits to be derived therefrom.")

2. An increase in the use of dry lumber through improved storage and drying prior to use.

3. The greater selection of lightweight packing materials readily accessible to the packing line and the recognition of the key position of the packer in the program.

4. The continued evaluation of the use of scales for weighing packs to make sure that the proper scales are used for the function performed and that accuracy of such scales is maintained.

5. Avoiding mixing of differently tariff rated commodities consolidated in the same shipping container - consistent with the technical specifications and needs of the services. This avoids costly tariff penalties against the lower rated commodities.

6. The evaluation in the use of heavy overpack containers for shipment consolidation and the re-evaluation of package designs for specific items. In this we encourage the use of awards and incentives programs for suggestions on technical redesign.

Our program further embraces the continuing study of container fatigue problems in relation to distribution problems and a thorough indoctrination of packaging and transportation personnel in the concepts and objectives of the reduction in weight and cube.

A phase of the program - not as yet significantly implemented - but one that is receiving important attention - is the development of communications - or, a system whereby the <u>shipper</u> is given more information as to the manner of distribution, storage conditions to be encountered and the length of time the packaging may be called upon to provide a state of material readiness. Such information can permit a scientific tailoring of the packaging to the actual

circumstances with attendant economies in packaging and handling through distribution channels.

The objectives of this "study" encompass all items of material requiring protective packaging to prevent damage in shipment and storage. Those items or categories of items offering the greatest potential savings through reduced tare weight and cube should, however, be afforded emphasis in the initial stages of each activity's program efforts. The areas of greatest potential savings are considered to be:

First, those items or categories of items accounting for an activity's greatest shipping volume and, secondly, those items of large cubic volume and varying densities on which transportation costs for individual shipments are high.

Now, as to actual progress to date. Most of the progress to date in reducing tare weight and cube has been made within the military field establishment where we are finding it possible to effect an over-all reduction of better than 30 percent in the original gross weight with no sacrifice in the packaged protection and, in addition, effect an over-all reduction of more than 40 percent in the original cube.

For every pound of tare weight reduced, an 11 cent net saving in transportation and material reclamation can be effected and for every dollar repacking costs more than $6.00 savings in transportation costs and material reclamation has actually been accomplished.

These savings loom in significance when one considers that our annual outlay for the transportation of 27-1/2 million tons of military items exceeds $64 million dollars.

Plus the fact that such savings represent a calculation against only the initial movement of an item in the system. Savings pyramid with subsequent handling and transportation.

Progress in the area of new procurement, which involves the inclusion of detailed packaging requirements in thousands of procurement documents for several million items, has been slow and infinitely more complex for numerous reasons:

Present specifications and standards often afford suppliers wide latitude in the selection of packages and shipping containers.

Although some progress has been made, and we are planning for a great deal more, few contracts contain package weight and size restrictions to permit enforcement by the Government Field Inspection Services. In the absence of these restrictions, inspectors are handicapped in determining what constitutes excessive packing.

Another area adding to the complexity of our problem with respect to new procurement is the fact that the weight and size of containers are not normally considered a factor in bid evaluation.

The prevailing practice of using standard size containers for irregular quantities and loads, which do not completely fill the container, generates excessive transportation costs, particularly for air shipments and vessel movement overseas and, additionally, contributes to damage in handling.

While progress in the procurement area is admittedly difficult, there is ample reason to believe that some of the problems are not insurmountable. Many contractors, who have become familiar with Government objectives in this area have taken voluntary actions within the framework of their contracts, sometimes by requested deviations to achieve tare weight and cube reductions. By doing so, they have not only contributed to the Government program but have also been able to effect significant savings in shipments to their own industrial customers.

In conclusion, we can categorize this effort to reduce tare weight and cube on military supplies as essentially a conservation program with its <u>greatest rewards</u> to be reaped in more efficient utilization of transport capacity when the payload of Government and commercial carriers is made to consist of the maximum feasible amount of net shipping weight.

Transport productivity is thereby increased and unit shipping costs correspondingly reduced.

For example, in lowering the average tare weight on air cargo by 50 percent we automatically yield 15 percent

more ton-miles capacity on aircraft formerly required to carry the same quantity of supplies.

We can apply similar formulas to our other carriers, including supply ships and, likewise profit materially through cube reduction in yielding additional storage space in our warehouses.

It is hoped that the objectives set forth in this presentation will stimulate progress by causing further evaluations of current efforts and the exploration of new areas for potential savings.

In closing let me give you the actual tare weight reduction record of one small air terminal processing less than 2 percent of the Navy's cargo airlift to the Pacific.

In the three years ending this past July the original weights of our packs at this small terminal totaled 1,189,805 pounds - we reduced this packaged weight to 864,453 pounds - sacrificed no protection to our material and saved half a million dollars in transport value at commercial rates.

I am sure that you will agree that we are exerting a sincere effort to stretch our portion of American defense dollars. I am confident that we will be materially assisted in the future by those in industry who are in a position to contribute, through the diligent application of engineering principles, to packaging for the military services in support of our management concepts.

Tuesday PM Oct. 11, 1955

How Can Industry Control Packaging Costs

Richard H. Thomas
Engineering Administration
Light Military Electronic Equipment Department
General Electric Company

Speaking to this distinguished assemblage of military packaging specialists culminates two years of intensive study of methods and costs of military packaging, and makes the effort expended really worthwhile.

Being a reserve officer in the Air Force, subject to recall in case of national emergency has somewhat influenced my decision to devote a great deal of extra time to investigate the problem of preservation, packaging, and storage of Military Material. Having both military and industrial knowledge at my disposal has resulted in conclusions entirely fair to both parties.

Until about a year and a half ago, costs of military packaging were computed on a percentage basis. On a yearly basis this method might average out so neither military nor industry would be concerned. However, on this basis industry could be penalized if the dollar value of all items for a period of one year was low, and on the other hand the military would be penalized if the dollar value of items for the same period was high. For example, a piece of radar gear approximately two feet cube, might be valued at 50,000 dollars, while another item of the same weight cube and fragility, might be valued at 100 dollars. Using five percent as a basis for packaging this would mean that I had 2,500 dollars to pack the first item and five dollars for the second. Both extremes are absurd but would hold on a fixed price contract. If the contract is redeterminable then adjustments can be made.

On all new bids for military business a request is being made to quote actual box, pack, and ship costs as a separate item, and not a percentage. When industry was notified that we would be called on to quote actual costs, it was difficult because records were based on yearly business rather than individual items or purchase orders. The only answer was to build up records of actual costs for future quotations.

For overall consideration we had two distinct problems, the major assemblies or systems, and the spare parts. For major assemblies we had a further consideration in that some of these items were to be packed for domestic shipment to the airframe manufacturer, and others were to be preserved, packaged, and packed for depot storage.

Taking these problems in order, our solution was as follows: In order to know the costs of packaging major components, a definite control of materials was required. This was accomplished by preparing assembly drawings showing the method, and purchase drawings for every item employed, except stock hardware - glue, etc. Two separate master lists for each system were devised, one for domestic, and one for export or depot storage. From our purchase drawings we know what our materials are costing for any given item. Then time studies were made, and every sample pack was timed when it was prepared for military tests in accordance with MIL-P-116B. From these sources a record was accumulated and analyzed in relation to time, method, and cube. This record enables us to compute the actual costs on future bids.

As I say this now, it sounds like a simple logical procedure; but believe me it was anything but that. To evaluate the overall costs we departed from this procedure on several tangents. For example, when we started our analysis we stocked material for most of the methods of packaging outlined in MIL-P-116B. When we started adding up the costs of storage area, plus deterioration of material, we quickly realized that we must either charge the military more money, eliminate some of the methods of packaging. This provided another tangent, to study the various methods - eliminate as many as possible, and still provide adequate preservation and packaging. The results of this research paid high dividends. We have reduced our packaging to method IA8, IIB, IID, and III. Before you get a chance to say that we must have several items overpacked, I will admit it, but at a lower cost to the military than if we were to stock materials for all methods and teach personnel the proper procedures. By reducing the number of methods we were able to mechanize our packaging lines and personnel became adept at the few methods required, thus, assuring a smooth flow of material through the packaging section. The end result - better preservation and packaging at a lower cost to the military. I recommend this type analysis for any installation manufacturing several different items. However, for manufacturers of a limited number of items, the lowest degree of preservation allowed in the specifications would prove to be the cheapest.

Another tangent which resulted in better packaging at a lower cost was our comparison of methods IIB, and Method IID. Investigation proved that we could preserve and pack major components in metal containers at the same or lower price than specification wood boxes with required protection and bracing. I have been challenged on this statement many times, and welcome this opportunity to again prove my point. The initial

material cost is higher, but labor, storage, and waste more than offset this initial difference. Picture if you will, a radar component, with a fragility factor of 15G's weighing 100 pounds. This item when preserved, packaged, and packed is subject to several tests; the most stringent being the leak test and the drop test on all eight corners from 30 inches without damage to the packaged item. To prepare this item for method IIB, a cardboard box is usually employed for the interior box. However, most components require several pieces of blocking and bracing to hold the item in place. The interior box must then be placed in a vapor barrier and heat-sealed. Then this barrier must be protected with either corrugated or some other overwrap. It is then cushioned into a style II wood box which in itself requires considerable labor to construct. After proper cushioning the box is nailed shut in such a manner that it requires extra labor to open it for inspection in the depot at a later date. On the other hand the metal container arrives from the container manufacturer with molded cushioning inside. The container can be opened, the unit inserted, and then closed so that it is ready for shipment in a matter of minutes. The container acts as an air tight barrier, an inner and an outer container all in one. Now let's compare costs. The container can be stored outside while all material for method IIB must be under cover. The labor average for a container is one-half hour while the labor average for method IIB is four hours. We have some operations that have been reduced from 8 hours to one-half hour. So far we have been talking about costs at the manufacturer's level. Now let's see what additional savings are afforded to the military. First, the weight and cube of the metal container is much less in most cases, therefore, you save on transportation costs. Inspection at the depot level to check desiccant offers the same labor savings realized in the initial packaging. When the field level calls on the depot for a new component to replace an inoperative one, the unit can be shipped in the container, and the inoperative unit returned to the depot for repair in the same container. It can be repaired and replaced in the container, and stored again. This cycle can be repeated any number of times. In this short time I cannot cover all the cost reductions, and advantages of metal containers.

I want to touch briefly on another tangent which resulted in lower costs, and that is our cushioning research. If we were to protect delicate electronic instruments against the rough handling tests required by military specifications, and do so at a minimum cost we had to know what material to use, and how much. Unfortunately manufacturers of cushioning material know little about their own product. They know the

deflection caused by static or stationary load, but do not know what cushioning value is derived from their product during drop tests or dynamic loading. To study and measure the effectiveness of any given material we devised a testing apparatus consisting of a metal container with an aperture cut in the side through which we could watch the cushioning material. For our dummy load we constructed a rectangular box in which we could place various weights to alter the pounds per square inch ratio. Next we fastened two impactographs to this dummy load to record the shock transferred to the packaged item. We then set up a high speed camera to record the drops. Then by calibration of an arm fastened to the dummy load which protrudes through the container we had our problem licked. From the impactographs we learned what shock was transferred. From the film we measured the distance of travel. By varying the pounds per square inch we pinpointed the effectiveness of any given cushioning material. Again our research resulted in an effective packaging operation at a minimum cost. Our testing device has been further refined by the use of a Statham accelerometer, and a Brush amplifier and recorder.

Speaking of tangents, I seemed to have strayed from my original theme of costs and control, but I must admit that these tangents have been the most interesting part of the whole program.

I want to get away from major components, and discuss preservation and packaging of bits and pieces. This is the area that provides the most headaches for packaging personnel, not only because of the volume, but because of the diversity of the items and the variance in costs.

Several factors complicate a standard approach to the packaging of bits and pieces. These factors are the type of item being produced; the quantity of items manufactured at any one installation, and the differences of opinion among procuring agencies as to the quantity per unit package; and even the method of preservation and packaging.

As I mentioned previously any manufacturing installation producing a large number of items might better establish a few methods and set up assembly line packaging. This will result in lower costs even though many items may be preserved, and packaged at a level above the minimum required.

The quantity per unit pack has a very direct bearing on the cost per unit. It is quite obvious that anyone can pack ten times in one pouch much cheaper than in ten pouches. But a cost for packaging this item cannot be established until the

services establish a quantity and hold to it. By the same reasoning a cost cannot be established until the services establish a uniform method. Under different contracts we have had as many as three different methods required for the same item, and quantities per unit pack that vary as much as from one to one-hundred. We have had this same variance within one service on different contracts. I appreciate how this can happen because common items are used in such diversified equipments, and the quantity needed to support these equipments vary with the frequency with which the item is used in the equipment. But this does not help industry when the services ask, "How much does it cost?".

I will admit from the beginning that we still haven't solved this problem completely, and because of its complexity we probably never will. However, we have done this much. For every item in a system, you, the military buy supporting spare parts. These we itemize on a form we call a parts list. Specialists review every item and prepare a 302A card recommending a method of pack according to military specifications. These in turn are submitted to the procuring service for approval before the actual packing is performed. When the item is available to the shipping department a sample pack is made and approved by the local service inspector. At this time the required materials are noted on a copy of the 302A card, and other information such as weight and cube are completed. Our planners time the sample package and establish a piece work rate; they also note the cost of material. All information except cost is then transferred to the master 302A card and copies are forwarded for final approval to the procuring agencies.

This procedure is not entirely in accordance with instructions but it is the only workable procedure we have been able to devise. When the initial card is made all information such as weight and cube cannot be obtained because the specialist must work from drawings in many cases. Otherwise we would hold shipment of all items pending approval of the cards.

To control costs we stock several items in graduated sizes and fit the item into the nearest material size. This eliminates costly construction of special material. These stock materials fall into three groups, BB boxes for light weight items, corrugated boxes for heavier items and exterior shipping containers, and vapor barrier pouches. By having standard sizes we can purchase in volume, thus, effecting the cost reductions to the services.

Recently I have read several military reports concerning the cost of the packaging program. These reports vary from

six to nine percent of the military budget. I am happy to report that by use of the controls outlined above my company has, during the past year, preserved, packaged, and packed all items at an average cost to you far below the national average of six to nine percent.

Morning Panel Session

Wednesday, October 12, 1955

Revision of Packaging Requirements

Commander G. L. Griffin
Office of Naval Material

I am sure that all of you will agree that the most advantageous course for industry and for the Government is to eliminate the need for changes in a contract or a specification. The best approach, it seems to me, is to have the specification right when it goes to print. Now that means that industry's best opportunity to achieve what it wants in a specification is during the period when that specification is being drafted and before it is finalized. Now typically a military specification will be drafted by some military agency. As an example, let us use the Bureau of Supplies and Accounts. The draft is then circulated to that segment of industry who has the primary interest or one of the primary interests in that specification. If it is not circulated to the entire industry, it will generally be circulated to the trade and associations which represent that industry. Before going to press, the majority of the changes and comments will be incorporated into the specification. Once a specification is in being, if industry feels that changes should be made, the proper course is to take up the question with the custodian of that specification. I think it is important that when the feeling arises that a change is necessary, that action be taken before the question is brought to a head as part of a contract because once a specification is incorporated into a contract, it is more difficult to change the specification because there is all the urgency of delivery and all of the other things which are connected with a contract.

Now the problem we are going to discuss is certainly not limited to packaging. The necessity for change in a contract or bid invitation arises in many areas, and we will try to attack the problem in general terms. First of all, let me say that the natural tendency not to rock the boat should be overcome. Contrary the impression which exists in some quarters, the military is always interested in progress, and we are not adverse to change. Bear in mind that the requiring agency who sets up the specification and incorporates it into the invitation for bid or request for proposal may often be too close to the forest to see the trees, and therefore to achieve progress in the area it is often necessary for some outsider to take a fresh look at what we are specifying and point out improvements which can be made; or point out, for instance over-specification. I don't think anybody realizes better than the armed forces

that we have no monopoly on good ideas. However, I would like for you to also take a look at the reverse of the coin. There are times when you will make suggestions which the military will find impossible to go along with, very often for reasons which they know and you don't know. While I would say that perhaps those cases would be in the minority, I would ask you to be a little patient when that situation arises. Give them the benefit of the doubt.

Now in these types of transactions, I think it is important to remember that the contracting officer is your clear channel for these changes. While it is often easier sometimes to go directly to a technical agency and talk with the technical agency, I would say that in the long run you will be better off by taking your problem to the contracting officer. After all, he is going to be the man who will ultimately change the contract. Conscientious contracting officers will take up the problem and will see that it is speedily resolved.

Now to take things in their logical order, I would like to discuss invitations to bid first. In discussing that, we may as well include the request for proposal used in negotiated contracts, although I am sure that most of you realize that the invitation for bid is a technical term, restricted to public advertisement. Now if there is any one general suggestion that a contracting officer could make on how to avoid trouble in dealing with the Government, I would say it is simply this: read the specifications. I think you would be amazed if you knew the number of requests which are received by contracting officers of all the armed forces after a contract has been made to increase the price of the contract simply because somebody forgot to read the packaging specifications and suddenly found out, after signing the contract and getting down to work, that the cost of packaging far exceeded the margin of profit allowed for the contract. I would say that of all of the places where we run into trouble, one of them is in packaging. There seems to be a tendency on the part of material suppliers to pass lightly over the specifications. I can tell you from some very sad experiences that that is a mistake. It is essential that invitations or proposals be gone over as soon as they are received, and not be allowed to lie around until toward the close of the period which has been set by the contracting officer for the receipt of bids or proposals. I say that for this reason: if you have a suggestion for change in the specification which is included in the invitation for bid, and that proposal is going to be studied

and run down with the technical activity and then finally approved, it must be put out to all bidders. And as you know, many of our bids go to well over a hundred bidders, so that there is just the processing time involved which, if we receive your suggestion for change—no matter how good it may be—if it is too late in the day, there are times when we will simply have to go along with the invitation as written, since time will not permit, say, the cancellation of that invitation and starting all over again. So I think that it is essential that when you make a suggestion for a change to an invitation for bid or request for proposal, that it be made in a timely manner.

Now the second point that I would make with regard to public advertisement is this: that where you do have a suggestion for the change in an invitation to bid and you are not in the position to make it in time but you still feel that it should be brought to the attention of the contracting officer, that you first of all submit an invitation to bid which conforms to the invitation for bid, because that will keep you in the ball game. It is always a sad thing for a contracting officer to open what is otherwise a very good bid in a public advertisement and find that somebody has bid, say, on an alternative method, without bidding on the method which was originally specified. When that happens, the contracting officer has no choice but to rule that the alternate bid is non-conforming, and throw it out. When he receives, one, a conforming bid, and, two, an alternate bid, at least you are still in the ball game. If the armed force involved feels that the suggestion has sufficient merit to it, it will cancel the invitation for bid and start all over again. But I urge you always to submit a conforming bid so that at least you will not be ruled out of the competition.

Once a contract has been awarded and production is under way, you may perceive a better or a money-saving way to do the job. The first thing to do is to check your suggestion or your idea with the cognizant inspector because there is a very good chance that he will have had experience along this same line with other contractors, or at any rate he will be able to give you valuable assistance. The next step is to write or to otherwise communicate with the contracting officer, and to outline your proposed change to him in enough detail that he can take the thing up with the requiring or the technical activity involved and make an intelligent decision on the thing without having to go back to you. If possible, I would suggest that you include

whatever cost data you have available so that the contracting officer will understand whether this is going to cost money, whether you feel that you will be in a position to make a rebate, or what. Now the contracting officer will get technical approval. Once that is secured, he will then negotiate the change with you. The final step in the chain is for the contracting officer to issue an ammendment to your contract.

Now when we start talking about invitations to bid and contracts, we are talking about legal entities. I thought, therefore, it would probably be valuable to you to let Mr. Coburn, who is a member of the Navy's Office of General Counsel, discuss some of the legal implications of invitations to bid and contracts with you.

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Revision of Packaging Requirements

Mr. George M. Coburn
Office of Counsel, Department of the Navy

Mr. Justice Holmes once said that persons, in their dealings with the Federal Government, must turn square corners. In connection with considering revisions to packaging and related requirements included in Government procurements, I would like to sketch very hastily and briefly some of the square corners or legal boundaries that come to play.

First of all, let's take a look at the making of Government contracts. As Commander Griffin pointed out, our contracts are made in one of two ways: they are either made by formal advertising on the one hand, or, in a fewer number of cases, by negotiation. The essential difference between the advertised and the negotiated method of contracting is that in the case of the advertised method there is very little, if any, leeway for bargaining or dickering of the deal. The supplier is pretty much limited to offering a price and delivery on the basis of the other terms specified in the Government's invitation for bid. Negotiation, on the other hand, at least contemplates that there be opportunity for dickering of the deal.

In connection with advertised procurement, the first step is the Government's invitation for bids. Ordinarily the Government tries to allow a minimum of thirty days for the examination and preparation of bids by suppliers. The invitation for bid ordinarily references the packaging specification. Those specifications may or may not be attached in a physical sense to the invitation for bid forms. In any event, those packaging specifications constitute an essential element of the invitation for bids. So, therefore, as Commander Griffin suggested, I would reiterate that it is of the first importance that bidders carefully review and that they understand exactly what is required by the invitation for bid in connection with packaging and related things.

If, after examination, it appears that a better way or an alternative way of accomplishing the preservation, packaging, or packing, is evident to a bidder, his main and probably only opportunity to suggest a change in the invitation in that respect is to communicate his suggestion to the contracting officer as far in advance as possible of the date set for the opening of bids. If the suggestion is meritorious and could result in a savings to the Government on the

one hand, and still meet the essential preservation, and packing needs of the Government, it is more probable than not that the Government will amend the invitation for bids to adopt that suggestion. On the other hand, the same suggestion stands very little chance of incorporation in that particular procurement if the suggestion is not made until after the bids are opened. Different considerations come into play at that point. For one thing, it is generally disadvantageous to other bidders, as well as to the need of the Government for obtaining the supplies within a reasonable time, to cancel an invitation for bid and to readvertise procurement after the bids have been opened. Any suggested change must have extraordinary merit, either price-wise or in terms of improving the quality, and thereby better meeting the needs of the Government as far as packaging is concerned.

Now let's first of all take a look at what a bid is, in the legal signification. A bid is a promise, a promise to furnish the supplies or services described in the invitation, at the prices and at the times stated by the bidder. It is, in business parlence, an offering. Unlike ordinary business offers, Government bids may not be withdrawn or modified after the time fixed for opening of the bid. You may ask, why does the Government impose this square corner? Why do Government procurement practices differ from ordinary business practices in this respect? I think the answer is not far to see. The Government procurement statutes by and large require that Government contracts be made by advertising. It is obvious that a procurement cannot be advertised if the contract awarded does not substantially resemble the contract that was advertised. If packaging method "a" is included in the invitation for bid and the resulting contract specifies packaging method "b", that contract I submit was not advertised. That means that any bidder who seeks to withdraw or modify his bid after the opening cannot—his modification or withdrawal cannot be given thought.

That does not mean that the Government has an indefinite period of time to consider the bids. The invitation forms ordinarily specify a period of sixty days, and the bidder is free to insert a shorter period of time.

Now then, so far as the packaging is concerned, unless the bidder expressly states otherwise in his bid, by citing the bid and inserting the price in delivery terms, he is

legally presumed to be bidding on the packaging requirements specified in the invitation. And if his bid be accepted, the packaging specifications set forth in the invitation for bids form an integral part of the resulting contract.

I have said that bids may not be withdrawn or modified after the time fixed for opening of bids. There are two exceptions to that—two principal exceptions—which may affect packaging. One is where the bid is late, or the bid modification is late, but the failure to arrive on time was due to a delay in the mails for which the bidder was not responsible. A second exception is where a bidder can establish prior to the award, but after the opening of bids, that he has made what we call a mistake in his bid. By that we mean that by reasonably persuasive evidence a bidder can establish that the bid he submitted was not the bid he intended. We frequently have the situation in which a bidder will tell us after the bids have been opened that he did not, for example, notice that the supplies were to be packed for export shipment. He tells us that was in the fine print somewhere, and due to the delay in receiving the specifications in the bid forms, he inadvertantly overlooked that. Well, if his price be substantially out of line with the other bids received, as well may be the case in some of his packaging, and if by furnishing his work sheets and other papers used in preparing the bids, he can reasonably establish that this export packing was not included in his bid, we have procedures whereby the bidder will be permitted to withdraw that bid from the consideration. There is also a further exception in that, where a bidder equally makes a mistake but not only can show that the bid he submitted was not the bid he intended—which is a negative showing—but can go beyond that and establish clear and convincing evidence of what his intended bid was. And if his bid, as corrected to conform with his intended bid, is the low bid and is otherwise eligible for the award, we also have procedures whereby that bid can be corrected. But these exceptions are no safe harbor in which to take refuge. The difficult legal questions arise as to the sufficiency of evidence of the mistake, and naturally we have to resolve the doubts in favor of the Government or to avoid prejudicing the interests of the bidders who are in the running.

The contracting officer has very little discretion in respect of the acceptance of bids. Basically he must accept the bid which conforms to the essential requirements of the invitation; and notwithstanding the price advantage to the Government of a low bid which does not conform to the

essential requirements in the invitation, he is not at liberty to accept that non-conforming low bid.

Now what is the test to determine whether a bid does or does not conform to the essential requirement of the invitation? The test is whether the deviation goes to the substance of the requirement so as to effect price, the quality, or the quantity of the supplies or services. Any deviation which has those characteristics ordinarily causes the rejection of that bid. As Commander Griffin pointed out, the only possible alternative to that is the cancellation or rejection of all bids and the readvertisement of the requirement. But that action will be taken only in very exceptional cases.

Turning for a moment to negotiated procurement, unlike formal advertising there is leeway to bargain or dicker packaging terms. Bidders or suppliers will receive ordinarily, under negotiated procurement, a document labeled "Request for Quotation". On the other hand, there is a technical difference between them. A Request for Proposals is similar in many respects to an invitation for bids in that the request is, that offers be submitted in response to the request. A Request for Quotation, on the other hand, is a request that the supplier furnish certain information which may serve as a basis upon which to commence negotiations, looking toward the making of a contract. The Request for Proposals, on the other hand, differs materially from the invitation for bids in that the offeror or supplier is not bound to keep the offer good or open for a stated period of time. He is at liberty, legally speaking, to modify, withdraw that offer at any time prior to that offer's acceptance by the Government. In that respect the proposal-type of offer is on all fours with the ordinary business offer. In addition, the contracting officer has greater leeway. In respect of what would be regarded as a non-conforming proposal, the Request for Proposal specifies again method "a" of packaging. The supplier states in his offer that he offers method "b". Under advertising, as I indicated, we would have little discretion there. Under negotiation, the contracting officer is at liberty to consider that alternative proposal on the merits. There are not present the jurisdictional bars in the exercise of his discretion which obtain in the advertised procurement field. If, on the merits of the alternative proposal, it is felt that the alternative would meet all requirements and would not increase our costs, then the contracting officer ordinarily would proceed to negotiate

procurement with all prospective contractors on the basis of that modification. Similarly, the mistake in bid procedure does not apply to the negotiated offerings. If the supplier finds he made a mistake in his proposal, he is at liberty--or should do so--to withdraw or modify the prior to the acceptance of the proposal by the contracting officer.

Let's look briefly at the administration and the performance of the contract after it has been entered into. For these purposes, it matters not whether the contract was advertised or negotiated. The same basic considerations apply. First, I want to mention the authority and responsibility of the Government inspector, who is ordinarily the immediate point of contact with the contractor. That inspector is required to inspect and accept or reject supplies strictly in accordance with the specifications and other requirements of the contract. He has no authority, unless the contract expressly states otherwise, to authorize changes in the packaging or related specifications. It matters not on the merits of the change, the fact that the change is a marvelous idea and will benefit everybody concerned does not vest the inspector with authority to entertain that change. In other words, contractors undertake departure from the contract specifications or the packaging specifications in the performance of the contracts at their peril. It has too often resulted in the rejection of the supplies due to the not-conforming packaging, with the consequent loss to the contractor which he cannot recover. If the contractor feels that better ways or cheaper ways obtain form performing the contracts so far as the packaging is concerned, he must obtain a contract amendment, setting forth the details of that change, before he is at liberty in the sense of being contracturally covered to proceed with the performance of the contract as changed.

Now a word about how these changes can be made. Ordinarily we have what we call fixed-price contracts. They impose an obligation on the parties--both parties--to perform the contract at the contract price regardless of the cost of performance. If the cost of performance is substantially less of the price, the windfall goes to the contractor. If it substantially exceeds the price, the Government, on the other hand, receives the benefit. These contracts vest what we call property rights in the Government to receive the performance at that price on the one hand, and to hold the contractor responsible for damages.

It follows that any changes in packaging must be supported by what we call consideration. If the change involves a reduction in the technical requirements, the change will have to be accompanied by a reduction in the price measured by the theoretical cost of the performance of the contract in accordance with the prior method. Conversely, in change in the specifications which increases the cost to the Government, it ordinarily cannot be undertaken unless it is clear that the Government's requirements have changed and those requirements cannot be met by performing the contract in accordance with its present terms.

In conclusion, I would say that you may quite well wonder what the underlying reason is for all these square corners, why they have to be turned, why the Government cannot engage in ordinary business practices in these areas. I think the answer can only be that all of us are charged with the obligation of spending your money—your money as taxpayers. And unless we have reasonable safeguards to avoid the waste or the misapplication or misappropriation of that money, we cannot effectively discharge our obligations as public servants.

Revision of Packaging Requirements

Mr. John Woody
Inspector of Naval Material

In the Navy, the inspector is a representative of the Naval Inspection Service, which is that organization which contractors contact after they have been successful in obtaining a Navy, Army, Air Force, or other Government activity contract, which requires Navy inspection or which has been referred to a Navy Inspection Office by another Government activity. I mention this initially for the purpose of familiarizing all persons with the Navy Inspection Service. Under the Defense Department procedure, there is established a single-service inspection; that is, the Navy inspects for the other services of the Department of Defense; and, likewise, they inspect for the Navy. This procedure establishes, under ordinary circumstances, one inspection service entering a plant in industry. From the contractor's point of view, the program is generally desirable inasmuch as he has only one inspection office to contact.

The inspector acts in the capacity of liaison representative between the manufacturer and the Government. Upon him rests the responsibility of seeing that the Government receives material in accordance with the contract specifications, drawings, or other specifications pertinent to the requirements as set forth in the contract involved. These requirements are set forth in all contracts. Aside from the material required by the contract, one of the most important items of the contract usually overlooked is the preservation, packaging, packing and marking requirement. Unless a contractor reads this requirement of the contract, he usually finds himself in difficulty and may suffer a considerable financial loss due to the requirements of the packaging specifications as outlined specifically in the contract, not having been adhered to.

I most urgently advise that everyone concerned with Navy, Army, Air Force, or other Government-agency bidding, give this matter careful and considerate study.

Your inspector of Naval material or his branch office is as close to you as your telephone, and he is always available—not to help you bid, but to interpret specifications and contract requirements, to furnish specifications, to advise you of any and all material that is on the qualified products list, which may be an important part of your contract. He is prepared to aid in the clarification of any information

contained in the contract which may need explanation, or with which you are not familiar.

To help you do this job, after you have obtained a contract, you receive from the Inspection Office a notice of instruction. This is just to help you interpret many things which are also a part of the contract. This document has valuable simplified information. If it is a difficult contract, the inspector would probably also contact you by phone or, if necessary, make a trip out to see you.

When in doubt, contact your inspection office in regard to packaging, packing, preservation and marking. Find out just what is required to prepare material for shipment to meet the requirements of the contract. Your inspector is trained to know what constitutes good packaging and packing requirements under the specification, and will furnish you with the instructions and information that you may need. In your area, there are establishments which do packaging, accomplish preservation, packing and marking. They have trained personnel who are familiar with all of the specifications necessary to effect the desired and required Government packaging. I am not trying to sell these men, but they are there when you are unable to do the work yourself. This has been ably published in a bulletin put out by the Commerce Department, to help you in establishing good packaging practices.

The inspector reviews all contracts requiring inspection, studies the requirements; and with this information readily available at his finger-tips, plans the inspection procedure with the utmost concern, to see that the Government is receiving material as required and set forth under the terms of the contract. He is also sometimes in a position to help clarify many of the specifications without going back to the contracting officer. They are there. He definitely can help you to interpret them. Any changes in the contract, after you receive it, would naturally come by way of the Inspection Office, with his indorsement to the requirements, to help you and the contractor to come to some particular terms or agreement.

The supervising inspectors have regular educational programs for the purpose of training, supervising, and thoroughly familiarizing their inspectors on these requirements. When time has permitted, contractors have been invited to sit in on these preservation, packaging, and

packing seminars. The manufacturers are invited to ask questions freely, for the explicit purpose of explanation and clarification, even of the fine print. It is essential and advisable that any and every manufacturer bidding on or accomplishing Defense Department work have at his disposal the latest copy of the specifications.

I should like to leave you with this thought: read thoroughly, carefully and comprehensively, the preservation, packaging, packing and marking requirements of your contract—as thoroughly and as well as you read and study the material requirements. You will profit, and the Government will receive from your place of manufacture, mill, foundry or factory, good material, made strictly according to the specifications, and packaged or packed properly. This will result in the happy combination of having usable material at the destination on time.

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DISCUSSION

COMMANDER GRIFFIN: Ladies and gentlemen, the only reason for our being here is to be of assistance to you, so we will now really turn this meeting over to you, to ask such questions or to raise any points which you would like. We will attempt, within the confines of our knowledge, to assist you.

MR. BABCOCK (Convair): Will we receive a transcript of this session?

CHAIRMAN: I understand that transcripts are being made. I would imagine that if you are going to need transcripts that you had better put in an order for them. I don't know how many they are planning to make. I don't know if they will get a transcript, but I think it would be well to check the desk.

MR. BABCOCK: As I gather, any interpretations would have to come through the local inspector, is this right?

CHAIRMAN: It should be. Now that is the normal chain on that, for you to write the contracting officer via the inspector. Ordinarily the contracting officer will either answer via the inspector or else answer with a copy to the inspector.

MR. WOODEY: If the contractor will contact the inspector, they will try to interpret and come up with a clear understanding of what is required by the contract. If it cannot be accomplished in that manner, then a letter indorsed by the inspector—not just forwarded, but indorsed—will go to the contracting officer.

Now if it is an important question of delivery on a particular contract, where the preservation, packaging and packing specifications hold up the delivery, sometimes a speed letter or a dispatch will be sent to the contracting officer so he can make the decision.

MR. BABCOCK: I am thinking of where we run into differences of interpretation between different people as to some of the batting and ground rules—say in a Type 1A plant, where the packing can be either a unit, intermediate, or final pack. There is some difference of opinion as to whether a unit pack, for instance, should get, say, a rough-handling test as the prototype. This interpretation then should come from the local chief of inspection, is this right?

MR. WOODEY: The Office of Naval Material has furnished,

through the supervising inspectors, to the chief distribution lists of the entire inspection service, a letter which definitely advises them of the test and visual inspection required on pre-production test or prototype and production test. The Office of Naval Material has outlined that definitely, conclusively, and it is very clearly interpreted.

MR. BABCOCK: That information is with the--

MR. WOODY: With the inspectors, yes, sir,

MR. FITZGERALD (Cadillac Products): I have seen lots of invitations for bid with just a reference to 116B. All right, you get the contract. Your inspector comes along, and he will have an entirely different interpretation. You should have the interpretation before you even bid the contract because regardless, if you package one way on 116B, it will cost you more money than if you do it another way.

MR. BABCOCK: There are a lot of differences in interpretation.

CHAIRMAN: I think Mr. Woody's point was that our office has furnished an interpretation to the Material Inspection Service on these points. However, I realize that we are never going to have a perfect organization as long as it is manned by human beings. As long as we have human beings, we are going to get variations of interpretation. However, if you are talking about where you have a difference of interpretation from the inspector--I understand that is what you are talking about?

MR. FITZGERALD: Right.

CHAIRMAN: Where you feel you do have a difference, the answer there, the man who will resolve it is the contracting officer. That is the proper place, I think, if you cannot resolve the interpretations with your inspector of Naval material or with your Air Force inspector, or whoever he may be. The proper man to take that question to is the contracting officer.

MR. FITZGERALD: That is true, but there is another thing that has to be thought about as far as contractors are concerned: that we have to live with the inspector. If we get tough with the inspector by going to the fellow above him, you are in trouble. That's all I can say.

MR. WOODY: I would like to answer the gentleman. I

have traveled this particular road not only in packaging but many collateral duties. I know in industry we have had more problems than the inspection service. I have heard that before.

As I look around the audience, I see that many inspectors are here. They are human beings. Many in the Naval Inspection Service, as well as the other services, have been to school. I have been in training with many of them. These fellows have definite technical departments in their offices that can resolve the questions for you. They also are governed by an Inspection Director, with whom you are free to talk at any time that you may call.

I would like to wipe out that particular thinking. Gentlemen, you are not in trouble. I have traveled the road for sixteen years now. Preservation, packaging and packing has been my field. I don't know it all. Many people here are my peers. I look around here and see some of the fellows who have taught me. But in sixteen years in packaging, I have seen it grow up to the military inspection that it is today.

Any time you see fit, go to your Naval Inspection Office, or to your Army or Air Force—or to whatever inspection office you deal with. The door is open. They will help you. And you will not be in trouble. Believe me, that is not the policy of our services. We have trained many. We are still training. Manufacturers definitely have been invited in to iron out their problems.

This idea of the inspector waiting around until the contractor is ready to do business—is not our procedure. We contact you people. And please, if I only leave you with this thought: we are human beings. We will give you every favorable consideration that we know how. Believe me.

I see these fellows that are inspectors. That is the purpose of inspection—to get good material on time. There are times when those problems come up that you speak of, but we are not the police action that you think we are. We are there to help.

CHAIRMAN: Mr. Cox of the Army had a thought on your question. I would like to ask him to enlarge upon it for a minute.

MR. COX: Are you from Cadillac?

MR. FITZGERALD: Yes.

MR. COX: It seems you do have a problem in connection

with interpreting your bid at the time of preparing. I have just made a note of that, and I will take it back and see what we can do in the Army to help on that particular point.

MR. LAPIDUS: I am with the Navy Bureau of Supplies and Accounts. I would like to make a few pertinent remarks on the subject of MIL-P-116B, and any other specifications or standards which offer a great variety of methods, types, grades, sizes, and classes, for optional use or for selection by the user of the document. Unless we take the premise that Commander Griffin made earlier and emphasized to a great extent by Mr. Coburn—the premise of careful examination of invitations for bid in order to make an intelligent bid—unless we know exactly what it is that we are bidding on, unless we know precisely what it is that we are using to arrive at the prices that we are submitting, when it comes time to have this contract administered by any inspection service, and I don't care whether it would be the Government inspection service or your own inspection service, someone is in trouble. It is like throwing a catalogue or a dictionary at someone and saying, "Here, take your choice."

Now somewhere in the initial reading and evaluating of this invitation, it must be assumed that someone knew on what basis prices were being arrived at. Now one of the greatest failures that take place in this packaging business is the fact—pardon me for getting to the roots of some of this problem because it does center to some extent in industry—is that the coordination that one might expect to find between sales departments and production departments and the packaging people concerned does not always exist. I have traveled the country very broadly and very widely and have found this to be an absolute case, that in many cases sales departments have been prone to slough off the attention to the packaging requirements, submit bids, and then later get the whole company in trouble. It is rather unfair at that point to say that your difficulties are with the inspector because the real cause of this disease took place long before that. This is merely a manifistation of the problem as it appears to the relationship between the company and the inspector.

As far as "116" is concerned, I would like to say this: it almost proves the old adage that it doesn't pay to volunteer for anything. But we did volunteer to try to do something about MIL-P-116B. I would like to say this openly and publicly: that it is one hell of a job. We have gotten thousands and thousands of comments. A large percentage of these comments were not worth the paper they were written on. A lot of the comments obviously were borne of immature reasoning, illogical reasoning, or inexperience. On the

other hand, there are some that are excellent. These, regretfully, are in the minority.

I would like to tell you frankly that there are hundreds and hundreds of these comments that are just 180 degrees away from each other and in direct conflict. Only a Solomon could resolve them. But after many trials and tribulations and the considerations of each and every comment that has come in from Government agencies and industry, we have tried to moderate this thing to the best of our ability. We have finally come to that point in the road where we are now typing a new draft of MIL-P-116C, for circulation to Government agencies and to selected portions of industry.

I thought this might be of interest to the audience here, because it may represent an important milestone on the road to improvement.

But improvement will not end with MIL-P-116C. In the research and development work we have done on this document, we have uncovered many areas where the answers are not yet known, despite the effort and money we have spent on it. There is still considerable work to be done, and there will probably be considerable room for interpretation still. But I would like to point this out as a summation: that if you get any documents—MIL-P-116 or any other documents—which are thrown at you like Webster's Dictionary or some catalogue without any definition as to what is wanted—method, type, grade, or size—the time to question it is at that point, and not wait until you get a contract and everything is legal and binding and you are forced into some "hassel" with a Government inspector.

MR. L. H. JOHNS: Commander, I have two questions, and one is an organization point. As far as our industry is concerned, am I right that the Armed Services Medical Procurement Agency is pretty much the one we deal with? Two, on what inspection service do we operate? Is it under Mr. Woodey or is it under the Army Inspection Service?

CHAIRMAN: Did you state the Armed Services Medical Procurement Agency?

MR. JOHNS: That's right.

CHAIRMAN: I am presuming your products are in the main by the Medical Procurement Agency?

MR. JOHNS: That's right.

CHAIRMAN: In so far as the inspection service which will inspect, it will be designated in your contract. There is a paragraph in every contract which designates who your inspector will be.

The Medical Procurement Agency, just for the benefit of those who may not be familiar with it, is a joint agency. It is composed of Army, Navy, and Air Force, which does the procurement for all of the armed forces. For that reason, it may designate an inspection service which perhaps has plant cognizance, so that it is a little hard to say. Mr. Boylan, do you happen to know?

MR. BOYLAN: I don't believe that the inspection for that agency has been assigned.

MR. WOODEY: Under the old system of inspection, if it were Army, Air Force, or Navy, it would be so stated in the clause that the Commander just referred to. But under single-service inspection, if you have sufficient business, you would probably have some inspector—whether he be Army, Air Force, or Navy—stationed at your plant.

If this is a procurement, this particular document or contract which you receive would be sent to the inspector cognizant of your plant. Now if it doesn't work that way and the Armed Services Medical Procurement Agency is dealing with, say, the inspector of Naval mâterial in some city, the Orders Section or Contract Administration Section would send that contract to the cognizant single-service inspection office which has jurisdiction over your plant. That is the way it is handled. That inspector—whether Army, Navy, or Air Force—would inspect the contract.

MR. BECK: The single-service has worked out excellently for all manufacturers, but I think where somebody does packaging for many contractors—that these people have been forgotten. We may have ten, twelve, or fifteen different customers with Navy, Ordnance, Army. The Army will come in and inspect the Navy in our place, and the Air Force will inspect Ordnance, the Engineers, the Navy. We may get ten or more inspectors at the same time, all inspecting other branches of the service. I was wondering if the services had given any thought to having single inspection in the packaging plants.

MR. WOODEY: Your problem is not only in your immediate area. In this area, we have the same condition.

That is a situation where single-service inspection is made on a local basis. But due to the fact that many things

happen prior in the single-service working, it would be a gigantic problem to ever change the particular setup, so the Army, Air Force and Navy have each elected to inspect in your particular plant.

The thing is that it is worked on a local inspection agreement. I believe that we are working now to resolve it.

There are some single-services inspections that will take over the respective plant. There is going to be a workable agreement. But it is with the policy makers to establish which agency goes in where. They are working toward that. But sitting in the audience are many people who have that peculiar problem.

I will say this: many manufacturers will be surprised how these inspectors talk things over. We work with them all.

MR. LINNELL: We have had trouble getting a hold of some of these specifications. In a bid for a contract, we have recently asked for the packaging specifications. They were not available to us from either the inspector, the contracting officer, nor from the Government Printing Office. We had to stall our bid as long as we could. We spent three or four days trying to get them, and we finally got a copy which we reproduced. I strongly suspect we got the contract because nobody else could get a copy either.

MR. LINNELL: Would it be proper to make a bid on the contract, stating that you could not get the particular specification?

CHAIRMAN: I wouldn't do it. If you want to know how I would handle that, I would start screaming every hour on the hour until I got that specification.

Mr. Cox of the Army points out that the situation you described is illegal, moreover.

One of our responsibilities is to furnish all of the specifications or to have them readily accessible. Now if that specification is not readily accessible—and, moreover, not available—the contracting officer is really running the risk of entering into an illegal contract.

MR. COBURN: I think one of your questions was: would it be proper to bid upon the basis that the specification was not available? I think that that would be interpreted to mean that the bidder was not bound by whatever may be in that specification. To that extent, it would have to be regarded as a non-conforming bid. Practically speaking, if you are

unable to get the specifications within a reasonable time so as to permit you to properly prepare your bid, I think the only thing you reasonably can do is to request the contracting officer to postpone the date for the opening of bids.

MR. LINNELL: There is one other thing I would like to ask about, where an item is a new item coming out that hasn't had specific packaging. Maybe they will call out MIL-P-116B on a method with nothing more added to it but that the item is complex and requires special packaging. How would you go about bidding on contracts of that type? Where different contractors could take a different view about the packaging?

CHAIRMAN: Are we talking where you have an advertisement which specifies MIL-P-116B? And you feel that that really in essence is the wrong specification?

MR. LINNELL: It could be the right specification. I have seen this come up, where you have to modify from a given section of the specification to get the proper packaging. It is impossible to get a package that will adequately protect the item under any specification.

CHAIRMAN: In other words, this is going to require a special pack which again is not covered by one of the methods in the specification?

MR. LINNELL: It would be a modification.

CHAIRMAN: There again I think that gets back to precisely what we were talking about at the outset, that as soon as you come up with that answer, after you have examined the invitation for bid, pointing out what the situation is to him, and asking him what does he propose to do about it? He is the right man.

That is one of those things that I say-- very often we are a little too close to the forest on this stuff. Again, remember that we have packaging sections at the requiring activity who are specifying, let's say, the pack that is to be used. Well, it gets to be that they start working within a given frame of reference. You know, it happens in your own companies. You tend to get into a groove and you don't go outside the groove. Somebody may routinely specify 116B, say, when obviously, after you look at it and examine it, that isn't the right answer. That is the time to quickly come up and point out to the contracting officer the deficiencies in his invitation for bid, and suggest a modification to that invitation for bid.

MR. LINNELL: Thank you.

COMDR. GRIFFIN (CHAIRMAN): Major?

VOICE: I would like to point out this larger question on the difference between the detailed specifications and performance specifications—and, speaking for the Air Force—there is the question of when you use detailed specifications and when you use Performance Specifications. It is an open question. It is one that hasn't been resolved and may never be. But I would say in connection with this problem, if any contractor, when he gets the Invitation to Bid--in looking over the specifications, it is felt for that particular item there should be a detailed Packaging spec rather than a performance spec, he should call this to the attention of the Contracting Officer, this may not help you much on that particular contract, but it may help you in the future. But get in touch with the contracting officer. The contracting officer will get in touch with the technical people involved and ask for a more specific packaging requirement.

I think another thing that would help in that area, is if when making a bid. you break out the packaging price rather than making it a percentage figure, so if you are out of line on the packaging cost--let's assume each bidder would do that—if one bidder was particularly out of line—high or low—this should wave the flag for the contracting officer, indicating that some bidders aren't giving enough protection or some are giving too much. I suppose he would know that such is the case. That would help. It is a problem, and certainly, we in the Technical Services are anxious to find out whether these detailed specs are required. It is an obvious impossibility to completely engineer the packaging for each item that goes out. We don't have enough people in WADC. The Army people don't have enough to do that for each weapon or for each specific item. In the Research Laboratories they develop the items according to the directives under which they operate. If they foresee a particular packaging problem, they are directed to call us—in the case of the Air Force—into the picture to get the right design before getting out to the procurement contract. We need your help. Please feel free to call us.

CHAIRMAN: Before moving on, there is one point still bothering me, and I'd like to give as much information on it as possible—and that is the availability of specifications. I want to ask Mr. Boylan who is from the Air Materiel Command (Wright-Patterson Field) to say where the specifications are available with regard to Air Force Invitation to Bid.

MR. BOYLAN: Normally, the specification would be in the requested bid. However, it is always in the AFPO (Air Force Procurement Office)--and Administrative Plan, who will provide the Specifications upon request. However, if they don't have it at AFPO, there is a special organization in AMC, in supply, and the symbol there, MCSIF, that has the responsibility for the distribution of Specifications Section will provide the specifications upon request.

CHAIRMAN: We will give that again "MCSTF" (Charlie, Sugar Item Force), --Wright Patterson Air Force Base, Dayton. That's the symbol Number. Stanley Cantor is the Contracting Officer, of Philadelphia. You are welcome to stop in and see the Specifications at our Library. If we don't have them we will try to get them for you.

As I mentioned before, what holds true with respect to the Navy, holds true for the Army--It is the responsibility of the man who issues that Invitation to Bid to also make provision for the specifications.

REPRESENTATIVE FROM BENDIX (SOUTH BEND): It is confusing to us when we get Contracts, well today a 1955 Form and tomorrow we may get a 1953 Form. What can be done to control those forms which are sent out to us, so that they will be up-to-date?

MR. BOYLAN: The Inspector at the Plant is responsible to supply you with the latest form, the latest Inspection Form and Specification, and it should be checked immediately.

CHAIRMAN: We have a question from the back of the room.

MR. BLAESS: (GUMMED PAPER COMPANY, CHICAGO): I am not going to present this in form of a question, because I realize it is too rough to expect to get an answer from you today. But inasmuch as this is a Packaging Symposium, somewhere in the record it should be brought to someone's attention: I know of some items which are packed for the Government which do not meet the specifications in every instance. I know that is a very serious statement. Fortunately, we have a group in our Industry working on this problem. There are also a group of Government representatives trying to solve this problem. But we manufacture packing materials, some are made to Government specifications and some are not. For sometime we were fortunate enough to secure business directly from the Government. The items I refer to, I'd like to identify, is a single procurement item and for years we supplied this item. Then, all of a sudden, we found that we were being under-bid. We are not crying because we can't get the business--the fact that we might be a high cost production company, which we are not; we are very competitive. But we have gone so far as to secure

samples of competitive items being purchased by the Government, which we have tested in our laboratory and have tested in an outside laboratory, and in every instance, not one of those materials have met Government specifications. I don't like to go through all the steps that we have tried to follow in order to get this thing handled. The thing is we can't afford to waste the time of everybody bidding on all the items you have referred to us.

I am the father of a 17 year old son (inaudible), but I am a taxpayer—and I don't want to see money wasted or money used wrongly, by my Company from a selfish viewpoint; but my Company isn't getting the business. It so happens that we are one of the very few people who will stand by our product. We believe in manufacturing a reputable product in line with our name, of what the Government wants. As I say there are two groups in our Association that are working on this and also a group of people in Washington. To date, we have accomplished nothing. I hope we will. But, at the same time, I don't think it is a simple problem. I do wish in the record that my Company recognizes that the Government is getting inferior products. It is a single procurement item, and I just don't think it is right.

CHAIRMAN: Has your Company or Association ever officially put the case on record in writing?

MR. BLAESS: No, my Company hasn't put it in writing officially. Just to the Procurement Agency; but no action.

CHAIRMAN: Have you gone to the next higher echelon?

MR. BLAESS: We have figured we had gone to the highest echelon possible. I don't want to name names or groups. I have been on the "soap" box now for two-and-one-half years. I don't think any of you gentlemen will feel I am making a play. This is a case I wish in the record rather than asking you how to solve it. But, at the same time, we have had some samples laboratory tested, and they definitely do not meet Government specifications.

CHAIRMAN: I would say this: We have had similar cases. As a matter of fact, I have been involved in cases similar to the one you described, and, speaking for the Navy, I think the Navy realizes that we have got an awfully large field to cover, and sometimes we don't cover all the field as well as we would like to, so it is essential that we get some outside assistance. And we generally are trying to take the thing up objectively as to whether this is an increase or where somebody who can't get his overhead down, we look into that. I really think that the Armed Forces try to

look at it objectively, and if it is within our power to do something, and something ought to be done, it will be done.

MR. BLAESS: We manufacture gummed paper and in that sort of business, you have to operate on an economical basis. It is not a case of economics of packaging---of too much floating cost. You just have to get certain results to perform specifications, and we are not necessarily components which can't meet that performance. I think you know our Company. We have the technical "know-how" and we have the technical resources behind us, and I think our technical resources are as good as any Company in the United States. Ours is not a case of uneconomical methods of manufacture. It is a case of here you must have the guts or you won't do the job. As I say, I don't say every manufacture don't have guts and meets the standards, but there is one other Company that meets the specifications from our standards. We have checked. I merely present that just is a case or one of the reasons why we are not getting the business. Our economic structure in the United States is geared to that. If you help the Government get that portion, you are not economically sound. I merely present that.

CHAIRMAN: A question from over here?

MR. SERGEANT (INSPECTOR) SPRINGFIELD, MASS: I wanted to raise a question about the latest revision of the specifications and I would like to get something from the platform on it. It especially pertains to the packaging materials as this Gentlemen (Mr. Blaess) has just mentioned. The specific question in mind: Is the latest specifications MIL B 121A, which supersedes JAN B 121 Amendment (2). The newest specification requires Qualification approval, but there is at the present time no QPL list available because of the one year shelf-life that is required in testing, and the new specification came out sometime in April, I believe, of this year. There are contractors, currently producing, or attempting to furnish I would say, materials on JAN B 121 Amendment 2 on contracts that have been issued after the date of the new specification, which was in April 1955. I would like to hear something from someone on the Platform as to where the contractors stand in that respect: Are they allowed to furnish JAN 121 Amendment (2) material or must they have a waiver of qualification approval for MILB 121 (A)?

CHAIRMAN: I hate to answer that one, but I will try. In general,—maybe I will hedge—. Major Helm, do you have a suggestion on that, or is there anybody from Ordnance who wants to speak for Ordnance. I can only say what the standard practices are on that type of a thing--the QPI maybe

not a specific answer. There is a storage requirement, and an interim QPL is published on items or materials for which all the tests have been made except the storage requirement, and then that interim approval is either verified or withdrawn at the end of storage period. This is what the Air Force does with the materials over which we have cognizance. This one happens to be at present, at least, a standard Ordnance responsibility and, if someone is here from Ordnance, specifically on this one, we have no reason to assume they are going to do otherwise. But you have to procure in the interim the interim approval waivering this requirement, then final approval after a year's period.

VOICE: I am familiar with this situation—I questioned Ordnance on that, how they procured under such a spec, and I was told it wouldn't be any for six months—the answer I got from Ordnance, was we'd just have to live with it.

VOICE: Being a supplier of grade "C" materials under 121, which met Military Specifications, the problem has come up to us in the past 30 days, and we have checked with Picatinny Arsenal, and found it possible for us to use Admendment 2 materials. Qualification samples don't have to be in to Picatinny Arsenal prior to November 1st for QPL. So it is impossible to be certified as no list has been made up and won't be until after November 1st. We are supplying Grade "C" materials even though new contracts are coming through with the military specifications rather than the JAN B 121 Amendment 2.

CHAIRMAN: Incidentally, I would like to acquaint you, on the question of Qualified Products and what the ground rules are—there is a Publication—the number of which I can't recall at the moment, which outlines the ground rules in general and I think the situation with which the Inspector of Naval Material is confronted may be covered in that. I hate to answer a question which is so specific as that, especially when there are a lot of people who are running a lot of different segments of this procurement, but in general, the answer to the question: What do you do when there is no qualified product or no list in existence, whether one is contemplated with respect to procurement, is to grant a waiver for that particular procurement. So that, as I say, I don't know how Ordnance is going to run this particular bid that they have got out. My answer is the general way you handle that situation.

VOICE: I have a question which involves both Inspections and Procurement Specifications. It is a hypothetical question, along the channels of the Gentleman from Chicago. An Invitation for Bid is issued and it states X, Y, Z products

are equal. It is pointed out to the Contracting Officer that there is a MIL Specification in existence—I might say un-coordinated specification, in one of its offices that it has a QPL. First of all, should not the other Services use this specification to complete the transaction, and call back the Invitation for Bid so as to use the MIL Spec? Now, supposing that they go ahead and use the Invitation for Bid as originally issued, then my question is: Who sets up the standards for it or the yardsticks to measure that product against the product mentioned in the Invitation for Bid?

CHAIRMAN: The Contracting Officer is the man who decides the standards. The Contracting Officer is the man responsible for that. When I say that, I don't mean that he is personally going to do it. He has technical advisors. In practice, the Invitation will generally require you to submit a description of your product sufficient so that he can make a comparison with the X, Y, Z, which he has cited as equal and he is advised by his technicians, and will then compare to see if the product which you offer meets his essential requirements.

If your product meets the essential requirements, he will consider your bidding, and if he feels that the essential requirements, which are incorporated into X, Y, Z are not met, then he will say that you are submitting a nonconforming bid.

VOICE: May he not use a MIL Specification as a standard?

CHAIRMAN: You are talking about if there is a MIL Specification out, which covers this product?

VOICE: Yes.

CHAIRMAN: I wouldn't know why he would be advertising "Or Equal" then.

MR. LAPEDAS (BUR OF SUPPLIES AND ACCOUNTS): The Gentlemen previously mentioned that this was an Interim Military Specification. I think it is important for us to know or realize that an Interim Military Specification or an Interim Federal Specification is binding only on that particular Department which issues it. It is there for optional use by other Agencies, but they aren't bound by it. I think we must realize that there are some requirements that the using agency--the one that issues this particular bid may take strong exception to. It is not binding on them until it becomes a coordinated document. When it becomes a coordinated document, it is brought to the attention of the Contracting Officer and of necessity he would

have to withdraw that bid and readvertise under a coordinated specification.

CHAIRMAN: That is the Performance Service Regulation. They say if a MIL Spec is in existence, it must be used. As a matter of fact "the or equal amendment" is a last resort. I don't think that any Contracting Officer in his right mind likes to use it. It is nothing but a headache.

MR. MOLDWIN (Inspector of Naval Material, Naval Material Office, New York): The man from Chicago, in the back of the room a few moments ago made a pretty serious accusation to the effect that defective material was entering the establishment of supply. That shouldn't be allowed to go unchallenged. I was wondering if the material was inspected by the Inspector at the Plant of the Manufacturer of that supposedly defective material? If it were, I would seriously think that that condition would be corrected if brought to the attention of the proper authorities. That is one comment I have at this time.

One other factor--On many occasions we notice certain plants in our area who may consistently produce defective materials which are rejected. Now the point comes up as to what could be done about preventing these unsatisfactory contractors from being given these bids by the Contracting Officers. In other words, what are the criteria for prevention of unsatisfactory bidders receiving bids in the future, when it's been established that the material that they have been producing has been unsatisfactory, or hasn't been satisfactory, where they consistently go to bat with the Plant contracting officer or request waivers. I was wondering whether the Legal Gentlemen--Mr. Coburn would care to comment on that point.

MR. COBURN: That would be a case for the Attorney General ordinarily. If we have information on the records of a Contractor who has records of unsatisfactory performance, if those records are serious, we have ways and means of disqualifying those suppliers from further Government business for a period of time. In terms of administration of a particular contract though the Inspector should realize that it is their job to reject supplies which do not answer the contract terms. Now, of course, the Government has the power under the terms of Contract to terminate a contract for cause if there is a failure to delivery within the time specified. That--may well mean that the contractor will not only fail to recover any costs that he has expended in performing the contract up to the time of the termination, but in addition to that, he may have to pay the Government any additional money it occurs.

Another procedure that we have concerns the duty of the Contracting Officer to award contracts to responsible suppliers. Whether a supplier is or isn't a responsible bidder is basically a matter for the discretion of the Contracting Officer. Ordinarily, there ought to be reasonable assurance that the bidder is qualified in the technical sense and otherwise capable of performing the contract in accordance with its terms. Obviously, the Government is interested in getting the material and not being involved in law suits. The fact you may have a legal right against a contractor who doesn't perform, is not only substantive for military suppliers, but--I think in summary that the gentlemen who raised the question that his apparently brief dealing with non-responsible suppliers may be slightly overstated--I think by and large we take pains to insure that the contractor performs. And where we have made mistakes, the Inspector has the job of making sure that unsatisfactory material is not acceptable in that contract.

MR. BENJAMIN (PRECISION LABORATORIES, PLEASANTVILLE, N. Y.): Is there a detailed procedure covering the determination of spare parts packaging, drafting, issuing and revision of PT Cards? I am concerned mainly with, not the way the PT Card looks or what information goes on it, but the various persons we have to see to arrange a change or a proposed change?

CHAIRMAN: This is a technical packaging question which I am not qualified to answer. I wonder if one of our packaging experts would like to deal with that, either from the Air Force, Navy or Army?

I wonder if you would repeat the question?

MR. BENJAMIN: There is a detailed procedure covering the determination of spare parts packaging, the drafting, issuing and revision of PT Cards. My main concern is not what information goes on the PT Card, but what persons do we see, how many cards do they wish, to what Government Agencies and that sort of thing?

AIR FORCE: In the Air Force that is covered in AA Bulletin 302A, also in AMC Forms 163-D. You will find detailed instruction there.

MR. BENJAMIN: In regard to the Air Force Spare Parts Packaging Cards--the quantity of cards varies every time they change Inspectors who control that item. From the District, one may want 1, 2, or 3. That furnishing the amount of cards takes certain amount of time--one time it may be 2 or 5.

MR. HARRING (AIR FORCE): That is brought about by the fact that oftentimes other than Air Force Agencies are involved. It may be a joint-Air Force-Navy Contract. You have to affect coordination while the Air Force is working on their portion, they have furnished these cards to the Navy from them to go ahead and do their share and come back to the Air Force with these cards of the Procuring Agency that follow on into the Contractor's office.

MR. BENJAMIN: If we wish to make a change, do either of these documents tell us to whom to go? Do we go to the Local Inspector? Or do we go to the Acting Chief of the Procurement District with whom we are dealing. What is the procedure?

MR. HARRING (AIR FORCE): I think the Commander pointed out this morning, you would go to the Contracting Officer and present your recommendation or your proposal to him. It would be up to him to contact the Procuring Agency.

CHAIRMAN: Go to the Inspector, then take it up with the Contracting Officers. But because, when we get into contractual changes, I think that the thing we must keep constantly in mind when we are in the contractual arrangement, and we start talking changes, we are talking on something which definitely is done legally, the man who legally represents the Armed Force involved is the Contracting Officer, if it is going to require change in the contract, he is going to have to issue you an amendment or change order.

MR. HERRING (AIR FORCE): I would like to point out one thing--During the Packaging Team Conference, which normally is held for the Contractors--Prior to accomplishing the packaging of Spares, it is normally agreed by the Contractor and Contracting Officer and the Packaging control that has cognizance of that particular packaging problem and they agree on how many cards will be reproduced and the distribution of those cards and that is contained in the cover document which goes along with our cards. We find in most cases that the Contractors agree to the number of cards that will be reproduced and oftentimes they don't agree with that. That is a responsibility of the Inspector as well as the Contracting Officer to insure that the contractor furnishes the number of cards that he agrees to at this particular conference.

MR. NEWELL: Wouldn't it help, too, when a factory packaging team has left your plant, to immediately take every card and go over it, and you will find 2 or 3 items which are almost identical, that will be packaged four different ways. That puts you in a bad spot, because your

men downstairs can't understand why they are packaging four items alike in four different ways. Those cards should be resubmitted.

MR. HERRING (AIR FORCE): Are you talking about Unit Packing?

MR. NEWELL: Everything.

MR. HERRING: Oftentimes, if it is a Joint Contract, the Navy-Air Force Contract--the Navy has one contract and the Air Force has another. I think in one of the presentations we had yesterday, the fact was brought out that the Navy has Destroyers and they had to have units for one, while the Aircraft carrier could accept volume. The Air Force, similarly is in the same situation with respect to space, they have bases all over the world.

There is a standardization document, which has been prepared, AMC Manual 71-2 which is intended to standardize all the methods and various packagings for these various pieces that doesn't cover the end object. That hasn't been distributed to the Contractor as yet, because it is being service tested by the Aircraft Industries. It seems to be the answer to all your needs, except unity quantities, and they will be provided at the time of the provisioning at the time of the Packaging Team Conference. I think once it is disseminated and the Contractors are familiar with it, this manual will resolve your problem you have referred to, because you will be allowed to package similar items in a similar manner.

VOICE: When does this go into effect?

HERRING (AIR FORCE): The first of next year.

VOICE: We have two contracts for spares and equipment--3 months later the items of spares are the same on both contracts. On the first contract, the PT cards were made up, approved and started back--everything was fine. The second contract--the PT cards were submitted, accepted, but the Agency in our area received orders to turn them down and new methods of packing were required, which cost more than the specifications that were submitted and approved locally. We ask: What packaging specifications were used to determine that method of pack that was re-submitted to us.

MR. HERRING (AIR FORCE): Without some specific example of what you are talking about, it would be difficult for me to give you an answer. We may find the methods initially prescribed were not adequate to meet the Air Force requirements,

and we also found that when we initially establish those methods we knew where the materials were going and the hazards to which they would be subject.

When the next contract came out, for the same materials, maybe it was going to an entirely different part of the world, which means we have to alter our requirements accordingly.

MR. BENJAMIN: We went through our Contracting Officer in our Sales Section, in other words, we asked, "What specifications were being used to determine the method of packing Change II, and we couldn't get an answer, other than they said that certain agencies were setting up different standards, when we are required to follow a specification, can't the Agency themselves tell us what to do on the next contract, because this can defeat itself.

MR. HERRING (AIR FORCE): Are you speaking of spares?

MR. BENJAMIN: Yes. We recall MIL P 116B for codeing the ANA Bulk and 302A.

MR. BENJAMIN: The Spec they were told to change, couldn't be traced down.

MR. HERRING: It is in your Form 163, right in the first paragraph.

MR. BENJAMIN: When we looked up the list of items-- the type of items and the method of pack required for that item, --the items inspected were being changed and 2 weren't listed?

MR. HERRING (AIR FORCE) AMC Manual 71-2 will give the type of preservation and unit and type of material used in packaging various type of metal fabrication, alloys, plastics— now there is nothing, but this Manual coming out will do that.

VOICE: Could we get an advance copy of that to look it over?

MR. HERRING (AIR FORCE): I would suggest that you ask the Packaging Division at Headquarters for Manual AMC 71-2 which was put out by the Air Force Laboratory. I think if you will be patient with them the Air Force will iron out most of your problems.

VOICE: PL 436 - one whole section has to do with the Preservation and Packing articles that are put in the Federal Catalog—but in such articles—AN standards—AN standard

parts, it don't spell that out. But my question is about standard parts, is there going to be a packaging requirement, for that particular standard part, which is uniform throughout the country.

MR. HERRING (AIR FORCE) This AMC Manual contains all codes that will be applicable to AN Standard parts and will be based on the type of metal that is in these particular parts.

VOICE: Are they going to have uniform quantities established for AN Standard parts?

MR. HERRING: I seriously doubt that you will have uniform quantities. Now there will be uniform quantities— in the catalog—

VOICE: Uniform packaging?

MR. HERRING: The methods of packing the parts will not be altered unless there are isolated cases where it is required.

NORTH AMERICAN AVIATION: I have a question: We have the same problem that this gentleman over here had. We have the same items purchased on two different contracts. Do you submit a card for both of those items? Although it is the same item?

MR. BENJAMIN: We use the one card and submit it for that contract.

NORTH AMERICAN AVIATION: When you get your other card and you have a card already for it, you don't submit another card.

MR. BENJAMIN: No.

NORTH AMERICAN AVIATION: Where you said that the Unit pack may have changed, although it is the same thing?

MR. BENJAMIN: After the second card was submitted, the Air Force recommended changes and sent the cards back— the method of packing they wanted was more costly and different than the original method on the first pack.

NORTH AMERICAN AVIATION: You sent the same card in?

MR. BENJAMIN: Yes.

NORTH AMERICAN AVIATION: In a lot of cases where the card has been previously approved, it needed be submitted?

MR. BENJAMIN: There were a lot of items of the same nature that they wanted packed differently than called for in the original contract--there was a difference in cost. In other words, we were being held up on delivery by holding the cards, and when we asked the question, we couldn't get the answer on what spec they were following on the next contract, with the same spec they were using and we couldn't get the answer.

NORTH AMERICAN AVIATION COMPANY: Could we submit a card already approved, again with different contract?

MR. HERRING: The answer to that question: If two contracts, two separate contracts procure the same item, unless there is a reason for a specific change applying to this class item, and it is brought out that either during a provisioning conference or after a provisioning conference, there shouldn't be another card submitted if that is already approved.

NORTH AMERICAN AVIATION: That is my interpretation.

VOICE: The public receiving agencies having so many cards coming to them, didn't know whether this was a new item or whether this was an item already in the Service being reprocured.

MR. HERRING: That is possibly what could have happened in that particular case. If you would, on these cards, state "This Packing method for this item has been approved and this is the approved method."

VOICE: We have a lot of Air Force Contracts from the Aircraft Industry. I imagine we handle something like, oh, 50,000 cards a month. You can see that those things go nice on a production basis and we try to standardize, and it could be that whoever had that one, thought it was a new item.

NORTH AMERICAN AVIATION: You mentioned in reviewing the cards, this similarity of parts--some kind of a preservative card, perhaps that card (inaudible)......

MR. HERRING: The method 3 Pack is merely a guarantee as to safety.

NORTH AMERICAN AVIATION: Normally, we shy away from that except when we know the material is going to be used--we have to put it on the shelf for shortage, and we would prefer Method 1 over Method 3.

VOICE: Occasionally we will run on to the card that's

been packed insufficient, perhaps, and they will revise that card, and you will get the revision on the card and invariably the card will be approved by the Air Force Depot who happens to handle that particular appliance. You may catch that card, and that card remaining in on contract will be served—the balance will be served another way.

MR. HERRING (AIR FORCE) The Contractor has the responsibility personally to assure that the most economical means of packaging the supply, and you find this particular item, the method should be upgraded. If you have similar items, I think it would behoove you to look into those and see if all wouldn't be upgraded. You have a responsibility to supply—to effect savings wherever you can. Any time you do that, just scribble a little note along with your card telling us why you did that and what you found, and I feel that surely in a majority of cases the Air Force would go along with you and probably give you a vote of thanks.

NORTH AMERICAN: How do you mean? I have a couple more questions—

CHAIRMAN: Could you hold up your questions now, I see we're running out of time.

MR. CANTOR: Your spare parts supporting end items are estimated in your contract. They will be incorporated in the Contract by the administrative—Contracting Officer at the Air Procurement District or, in your case, Mr. Church or Mr. Brown--bring your problem to them and, if there is an increase in pricing, it will be negotiated at the time your negotiating the incorporation of spares in the contract. Up to that point they have been provisioned—they are only an estimated part of your contract, and they will become a formal part of your contract after their fait accompli.

CHAIRMAN: I think we have a comment from the Air Materiel Command—I want to clarify one point. Please don't write to Headquarters at AMC as Mr. Herring has suggested. If you run into any trouble let us know. We know the distribution of the Manual. If you can't get them from your regular source, then come to us. They don't want all these letters coming in.

VOICE (Weir Aeronautical Division): We have been packing aircraft spares since 1951 based upon ground rules established at that time within the Military, and as a result of a recent Navy Provisioning Team Conference I was given a packaging formula which is within the limitation of 116B of course, under which we are allowed maximum unit quantities of small items up to a thousand. In AMC Manual

71-2--the maximum quantity formula is 100 pieces. Now, I would like to ask Mr. Boylan if there is at this time a standard, developed formula or will there be one which will give the proper quantity to the Navy, to the Air Force for part X and it will be packaged in the same manner and preserved in the same quantity. Personally, I don't care how they want it, I will dip the chocolate to suit, but I want to know exactly what they do want.

MR. BOYLAN: I can't answer that at the present time. Perhaps, I will call on Mr. Curtis and ask if you will give us any information on that.

MR. CURTIS: Do you have a standard quantity for the 3 services?

MR. WEIR: Yes, that's the question.

MR. CURTIS: We have different items in the Air Force and Navy. Many times, some parts of the Unit packaging by the Navy, for example, is much less than we can economically package because of the different supply problem we have had. We have an informal agreement, let me say we do our best to go along with the fellow who needs a smaller quantity. When we buy resistors or whatever it might be, it will be ten for each of the services.

MR. WEIR: I'd like to point out that when the original supply packaging operation was layed out it was planned that the equipment was to be bought in order to stay within the confines of MIL P 116B. Now this no doubt is a valid request from the ASO and USAF. I appreciate the fact that there are maintenance and overhaul factors, probably dissimilar within the services. I don't know, but the thing that I am trying to bring home is that if we know and if we are bound to abide by that request, it means that I have to revamp, re-staff, probably add additional manpower, re-lay out my packing area and mechanize a great deal of equipment, because we are going through a lot more packaging operation. We will be eliminating surplus lines and we will be expending a considerable amount of money for preservation lines going into a dry pack, and will necessary eliminate some of that volume. So it is just that we know when a contract is let that we have the proper performance to that spec and it is so written.

CHAIRMAN: I am trying to figure an ASO team asking you to do something different about it.

VOICE: It is within the total confines, if I am

allowed the maximum uniformity of pack on small items of 116 and 71-2 on maximum quantity. The ASO-USAF Formula is 100.

VOICE: What I am to do is to submit my request list to Middletown, there the parts of it from the Depot will be submitted for screening, it will then come back to Middletown. Middletown will submit to ASO for Conference, and they will come back to Middletown and come back to me and tell me how to pack. I don't think they need do all this. All I need is the formula--the same one they use, to get the possibility of error. All this screening, in my opinion, isn't necessary if there is one basic formula.

CHAIRMAN: Has a basic formula been included in that specification or not?

VOICE (CURTIS WRIGHT AERONAUTICAL DIVISION): There's been quite a bit of work done between Middletown and ASO on that--the spare parts formula were you formerly talking about is more or less in an experimental stage right now, and it wouldn't do any good to use that Formula on many parts. We have found these quantities of 1,000 that you speak of. They are too great. We can't possibly live with quantities of 1,000. We have to issue the unit pack quantities. So I think the thing agreed between Middletown and ASO is the only way to resolve and come to a joint Service agreement on these unit pack quantities.

MR. WEIR: Thank you.

PRATT-WHITNEY: Again, we are having the same problem. We are under the cognizance of the Navy. In our latest contract, I know this formula which we have been talking about is being included with respect to the spare parts. And one of the questions is that we are also to supply this material to the Air Force through the Navy, and the Air Force doesn't like the quantities, and we have to request change in cards as to the Air Force quantity requirements.

CHAIRMAN: Did you say your Formula is included as part of the contract?

PRATT-WHITNEY: We are being asked to include it now.

CHAIRMAN: I think it gets us right back to the point--It doesn't make any difference once you have signed the contract, if somebody wants to change it, that becomes a matter of a contract change. But if the formula is included in your contract, then it was what you and the Government agree to do.

Now at that point, let's say, the Air Force decides, after you have the contract, they don't like the way it is working out. Then that is a subject for negotiation between you and the Contracting Officer to make the change and it would cost you money. I presume you will be reimbursed, if it costs you money?

PRATT-WHITNEY: Let's get back to Public Law 436 that requires, as I understand it, most of these things are going to have FINN Numbers and packaging specifications are supposed to be used for that.

CHAIRMAN: Let us look at Public Law 436 for a moment. If we are going to full implement Public Law 436 by, let us say, one year from now, my guess is that you would have to build a new Department of Defense somewhere in the middle of the United States and pull about one million people in there. It gets down to the question of what is it physically possible to do. There are a lot of short-comings that we realize. There are a lot of things that right now we know ought to be done, but we simply don't have either the men or money to do them--we have got them up on the shelf somewhere and we hope that as soon as we can physically do it, we will get to it. But it is like a lot of other things, given the resources that we have, we have got to take things in a certain priority. And what we tried to do is to use the brains that God gave us and assign the best priority that we can figure out and work along that line.

CHAIRMAN: Yes?

LAPEDAS (BUREAU OF SUPPLIES AND ACCOUNTS): As I understand the Standardization Program --its purpose is to achieve the highest practical degree of standardization. Now the thing that encourages me as I listen to the chatter back and forth about the Unit Packaging--is that Industry and the Military Services are trying to find a way of solving a complex problem. This thing is not easy, and it would be a gross over-simplification to say that it is.

Another aspect of this is the fact that in order to introduce greater economy in packaging, we have a new Department of Defense policy which attempts to adjust certain levels of protection to known or anticipated conditions in the field, and they set up different levels--immediate use, domestic storage and receipt and overseas and long-term overseas and that sort of thing. So, in effect, the services are being encouraged to try to achieve the economies desired by Congress. Now, in order to do so, it is entirely conceivable that one manufacturer could be packaging at different levels for different services. For how else can this be

accomplished. The business of standardizing on packaging, merely for standardization's sake alone, is not practicable. It can't be achieved 100 percent down the line. To achieve uniformity where it is economical and practicable to do so and where it meets the operating requirements of the Service is our goal. If it doesn't meet those requirements, it isn't worth doing.

CHAIRMAN: We received a question at the "break" regarding the Packaging Course which is given at the Rossford Arsenal. I would like for Mr. Woodey to take a minute to give you the details on that, because we are interested.

MR. WOODEY: I listened to Captain James R. Gleason of the U. S. Army Arsenal Roosford Ordnance, say that this Joint Military Packing Course is available to all manufacturers who have Government contracts.

You must, as I understand it, send to the Commanding Officer at Rossford Ordnance Depot, Toledo, Ohio a request for the number of personnel you desire to attend and the numbers of the contracts on which you are working. The course is free, all other expenses must be borne by the Contractor. It runs for a two-week period. You must direct your request to the Commanding Officer who, will screen your letters and, if he has a possible opening schedule for your men in the course.

CHAIRMAN: (CDR GRIFFIN): Ladies and Gentlemen, speaking for the Panel, I want to say we have certainly enjoyed this Session and we hope that we have been of some help.

Morning Panel Session

Wednesday, October 12, 1955

A2. Specialized Materials Handling Equipment Requirements
Chairman, Commander R. E. Fullam, SC, USN
Supply Research and Development Facility
Bayonne, New Jersey

Equipment which has been developed to meet specialized military operational requirements.

Panel Session A-2 Wednesday AM Oct. 12, 1955

Certain Materials Handling Assemblies Developed to Meet Specialized Military Operational Requirements

Commander R. E. S. E. Fullam, SC, USN
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Introduction: My discussion this morning will be confined to certain materials handling assemblies which have been developed by the United States Naval Supply Research and Development Facility to meet specialized military operational requirements. Further, this discussion will be based upon the results of evaluations of these assemblies during their utilization in combatant ships during replenishment at sea operations.

With the development of newer tactical and strategic concepts for modern Naval warfare, it was inevitably axiomatic that there would also be created a demand for the development of newer cargo handling techniques and a demand for the development and design of modern materials handling aids which would implement effective replenishment-at-sea methods.

These new techniques and equipment should be of considerable interest to packaging men because of their possible influence on packaging specifications.

Replenishment at sea, or underway replenishment is essentially the supplying of the Navy's fighting ships in a given area of operations without requiring ships to leave the operational area in order to replenish at some distant friendly port.

Underway replenishment, as we know it today, had its inception in World War II, but its influence on the Mobile Logistic Support Concept was perhaps not fully realized until the outbreak of the Korean War in June of 1950. During the early campaigns of that War, the urgent need for specific materials handling equipment was voiced by the operational personnel of the Fleet then in Korean and Japanese waters. For the ability of a ship to replenish underway is an essential military characteristic and the ability of a Fleet to maintain itself and operate in any given area for long periods of time is largely dependent upon the proficiency it can assume during the underway replenishment evolution.

The military factors involved in underway replenishment operations are many and complex, and need not concern us here. It was, however, of paramount military importance to devise techniques and design assemblies which would:

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a. Permit replenishment evolutions to be conducted with a minimum interference with combat readiness.

b. Permit the removal of cargo from transfer stations and its stowage below decks at the highest hourly tonnage rates consistent with safety.

c. Permit the operation to be conducted in a minimum time, and

d. Conduct the operation with a minimum of personnel, consistent with other considerations.

Heretofore, investigations conducted in the field of underway replenishment techniques and the improvements accomplished had been, to a large degree, confined to delivering AF type ships. We shall speak here only of certain assemblies utilized on combatant ships.

Analysis: The successful development of the vertical pocket conveyor by the United States Naval Supply Research and Development Facility, for use in delivering AF type ships has eliminated, to a great extent, the difficulties encountered in these ships, and by increasing the rapidity of transfer, and increasing the rate of tonnage transferred to the receiving ship, created an urgent demand for improvement in the techniques currently in use on receiving ships; and also, postulated the development and design of materials handling assemblies peculiar to the requirements of the ships involved.

The necessity for such improvements was dictated by the fact that the ability of the delivering ship to transfer cargo to a receiving ship, exceeded, as a general rule, the ability of the receiving ship to accept the cargo, segregate it and strike it below decks, even though it was the rule rather than the exception for receiving ships to go into underway replenishment operations on an all hands evolution basis. Obviously, it would accomplish nothing to solve the difficulties of a delivering ship without taking into consideration the difficulties of the receiving ship.

In order, therefore, to overcome the difficulties regarding underway replenishment operations inherent in receiving ships, the United States Naval Supply Research and Development Facility designed, developed and utilized on combatant ships numerous materials handling equipment assemblies. Four of these assemblies will be discussed here, the vertical tray lift conveyor, the telescopic aluminum chute with abrasive retardent covering, and the vertical cloth baffle retardent chute.

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Problems: For the design and development of these assemblies, four basic considerations were first regarded:

a. Their initial cost.

b. Their maintenance cost, and the possible elimination thereof.

c. Their overall efficiency.

d. The final effectiveness in operation.

Furthermore, their physical characteristics were a matter of paramount importance since different type ships would necessarily require different type assemblies to fit their peculiar needs. Therefore, the following physical characteristics had to be considered:

a. Their size

b. Their weight

c. Their capacity

In addition, their operational characteristics were considered on the following basis:

a. Their life expectancy

b. Their susceptibility to damage with constant usage

c. Their cost of operation

d. Their personnel requirements and the reduction of such to a minimum

e. Their reliability

Discussion:

The Vertical Tray Lift Conveyor

General description: The main operational feature of the vertical tray lift conveyor, platform type, is that the lifting platforms, when in the lifting position, are in a horizontal plane and as they pass over the topmost point of the conveyor they assume a vertical position for their downward movement.

This advantageous feature permits a compact design and permits installation on ships within exceptionally limited space.

a. The trays are on a 43-inch center to center distance along the chain.

b. The trays are manually loaded, waist high, with automatic pickup and the machine was geared to hoist sixteen trays per minute, or at a maximum rate of 48 tons per hour.

c. The discharge, at the topmost point of the machine, was by manual removal.

d. During its operation, the equipment was used to capacity only at short intervals because of occasional interruptions in the flow of crates.

e. The operation of the machine can be reversed and crates or bags lowered at the same rate.

Control: Control of the machine is maintained at both upper and lower levels. An enclosed box on the lower level contains a reversing magnetic starter with differently coloured push buttons marked UP/DOWN/STOP, and on the upper level, STOP. Thus, control is exercised at both levels.

The lift in the ship in which it was installed was at a height of 17' 4", but the machine can be built to fit particular heights on an, "as desired," basis.

Construction: The machine is a portable type conveyor. The frame consists of angle iron, number 14 gage sheet guard over the drive chain, and number 16 gage sheet guard around the conveyor.

As the lifting trays approach the top of the conveyor, the attached roller cams, by movement in their restraining channels force the trays to assume a vertical position for their downward travel. As the vertical trays reach the bottom of their travel the roller cams move the trays from a vertical to a horizontal position for loading on the upward travel.

The special feature of the tray control, which allows them to assume a vertical position on their downward travel, is a great space saver.

The packages are loaded manually to the trays 22 inches from the deck. The discharge is 17 feet 4 inches high through the top of the unit. The discharge is also manual.

The vertical tray conveyor is designed to rotate at a speed of 16 trays per minute. Carrying 100 pounds, one unit will deliver 48 short tons per hour.

The vertical tray lift conveyor is a development of the Kornylak Engineering Company, 517 Communipaw Avenue, Jersey City, New Jersey. Its basic characteristics are as follows:

a. Serial Number: VTC 1

b. Manufacturer's Serial Number: 1337

c. Drive: Electric. 1/2 H.P. Totally enclosed. 220/440 Volt - 3 phase - 60 Cycles - Gearhead Motor with chain to conveyor drive shaft. Reversing magnetic starter with UP/DOWN/STOP station at lower level and STOP station at upper level.

d. Capacity:

(1) Maximum packages size 19" x 36 " high by 100 lbs.

(2) Trays on 43" center to center distance along the chain.

e. Speed: 16 trays per minute. However, sprocket spares are supplied and can be installed to obtain either of the following speeds: 10-1/2 trays per minute and 20 trays per minute.

f. Lifting Rate:

(1) Lifting 100-lb. crates at the rate of 16 trays per minute; 48 tons per hour.

(2) Lifting 100-lb. crates at the rate of 20 crates per minute; 60 tons per hour.

(3) Lifting 100-lb. crates at the rate of 10-1/2 trays per minute; 36-1/2 tons per hour.

g. Loading Height: Manual load to tray 22" high with automatic pickup by tray.

h. Discharge: 17' 4" high through topmost point, with manual removal of crates.

i. Dimensions: Body 34" wide by 30" front to back. Height - 17' 4".

j. Guards: Number 14 gage guard over drive chain. Sixteen gage housing around conveyor, angle iron guard at top to prevent crates from falling off carriers.

k. Weight: 2,000 lbs.

Performance: This assembly was utilized to hoist thirty tons of cargo, consisting of one-hundred-pound crates from the main deck of the ship to the 02 level, a height of twenty feet. Heretofore, the same tonnage was hoisted by line and required from six to eight hours to perform the operation with accompanying alternate shifts of men. The tray lift deposited the crates on the upper level at the rate of sixteen per minute. Had the machine been operated at its maximum efficiency the total tonnage could have been hoisted within thirty-eight minutes.

The savings in manpower and time utilized for the operation is a striking example of the successful performance of the machine.

The Lightweight Aluminum Gravity Skate-Wheel Conveyor

General Description: The lightweight aluminum gravity skate-wheel conveyor developed by the Facility for use in speeding up underway replenishment operations is similar in design to the type of conveyor presently used in commercial warehouse operations. However, the Navy requires certain features in their own conveyors which vary from those in commercial usage.

Naval usage exposes its conveyors to extremes in both weather and rough handling, hence the side channels are deeper than those found in normal commercial warehouse operation, and the steel wheels and other steel parts are cadmium plated because of the highly corrosive salt spray conditions encountered during the underway replenishment evolution, also the ball bearings are protected from these same weather conditions with a special type of raceway construction.

Construction: The lightweight aluminum gravity skate-wheel conveyor as currently used in the Navy is fabricated in

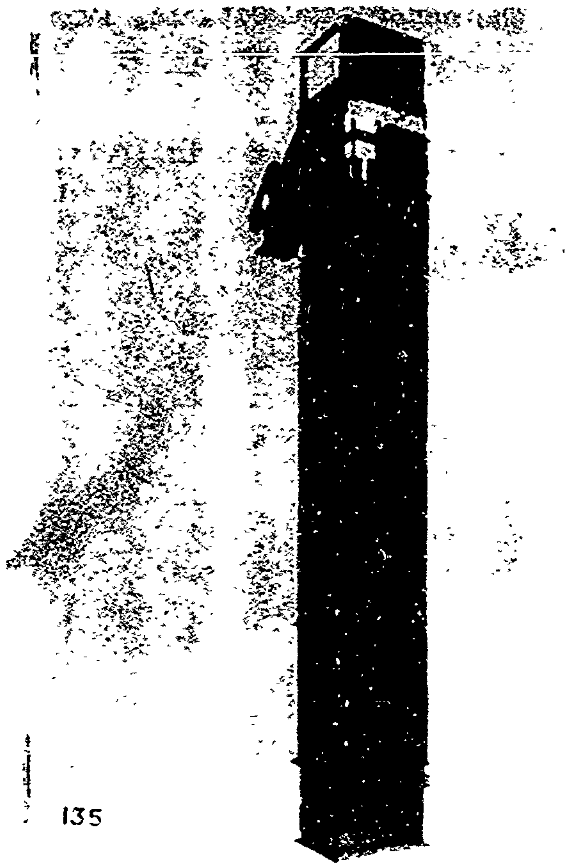

Fig. 47

General over-all view of the vertical tray lift conveyor. Reversing features permit discharge from 02 level to main deck. Note guards along upper portion to prevent packages from falling.

Fig. 48

View showing the discharge section of the tray lift conveyor. Note that as the package approaches, it is manually removed from the unit. The lifting tray then changes from a position at right angle to the axis of the conveyor to a position parallel to the unit.

Fig. 49

The tray lift conveyor in operation. View of the lower level with man stationed at the control.

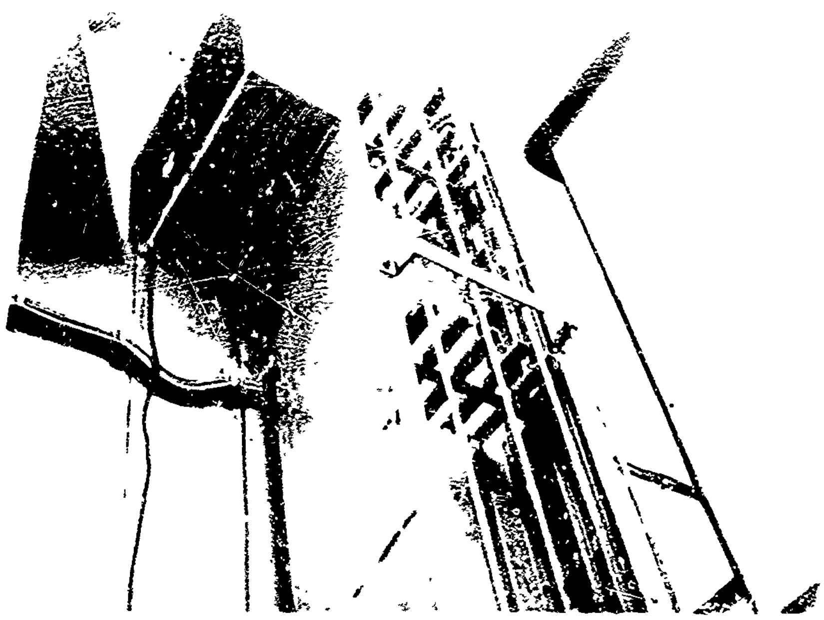

Fig. 50

View of the discharge section of tray lift conveyor looking from main deck to the 02 level. Note sheet metal and bar type guards used to prevent packages from falling.

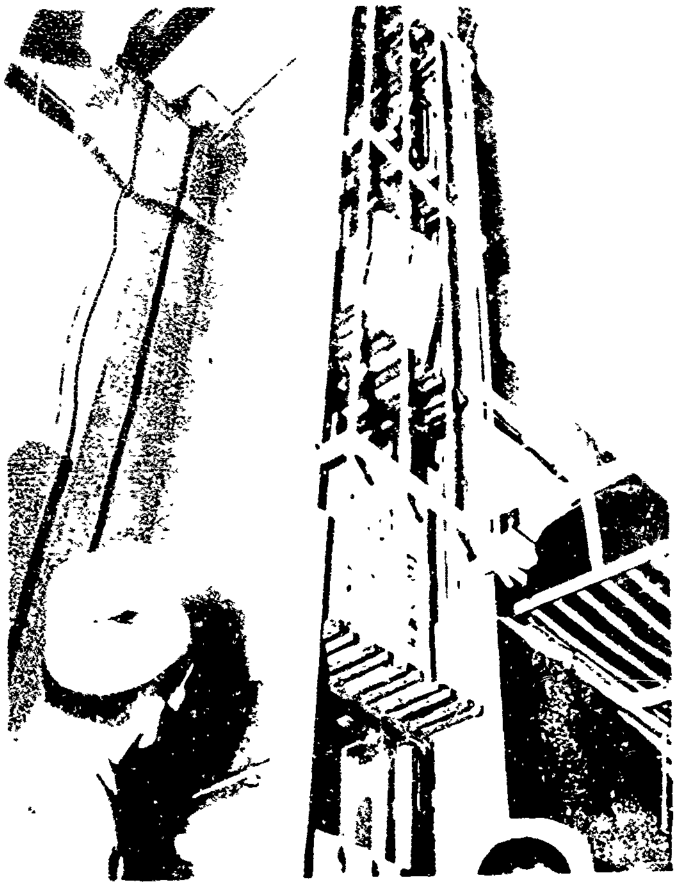

Fig. 51

View of tray lift in operation looking from main deck to the 02 level.

lengths of five and ten feet. The accepted widths are twelve and eighteen inches. We shall discuss here the twelve-inch width.

Conveyors are made of aluminum alloy (61 ST) and conform to Federal Specification QQ-A-327a, 21 June 1951, unless otherwise specified. The side rails of the conveyor consist of two formed aluminum alloy channels .125" thick. The channel sections have a web of 3-1/2" with 1" flanges. The end connections for each flange are rounded off and drop-forged which prevents the tearing of overhanging packages and provides required toughness. The side rails are mounted parallel to each other with the flanges turned to the outside of the conveyor. Further, the side rails are aligned and adequately braced by means of three or more cross members for a 5' section and five or more cross members for a 10' section. These members are made from formed extruded aluminum alloy and are securely fastened to the side channels by means of two through bolts for each member. The cross members are spaced between the first and second set of wheels at each end of the conveyor and uniformly in between. One-quarter-inch diameter holes are spaced at 3" centers to receive the wheel axles. There are holes for 20 axles in a 5' section and 40 axles in a 10' section.

Three aluminum longitudinal strengthening bars 1" x .125" are spaced between the channel frames for 12" wide conveyors.

The wheels are made of cadmium plated steel and have a diameter of 2" and a face of not more than 5/8". They have hardened inner and outer raceways and are free running. The design of the hub is of the baffle or labyrinth type to keep grease in and dirt and water out. The construction of the complete assembly is so constituted to prevent salt water corrosion during use and during its storage at sea. The wheels are mounted on 3" centers, 16 per foot for 12" wide conveyors.

Five-foot sections of this type of conveyor will hold 1,050 pounds if the conveyor is supported at each end, and under the same circumstances a ten-foot section will hold 525 pounds.

The five-foot sections of the assembly have a total weight of 25 pounds and the ten-foot sections of the assembly have a total weight of 50 pounds, and, therefore, the spotting of the equipment, its removal and stowage after use is a matter of easy accomplishment.

Fig. 52

The application of lightweight conveyors on main deck moving supplie from the segregation poin to the striking zone. Note the comparative use of manpower in this view.

Fig. 53

Showing the application of lightweight conveyors to effect the lateral movement of supplies through superstructures.

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Note

Fig. 54

The long white line. In order to meet the standards of the Commander, Sixth Fleet for underway replenishment operations, the use of manpower alone is not enough.

Performance: Experimentation has proven that during replenishment at sea, the skate-wheel type gravity conveyors are preferable to the roller type. The heavier rollers, having higher inertia, absorb more energy when packages pass over the conveyor, and as a consequence, more manpower must be used to move the cargo. Conversely, the skate-wheel conveyor will move a package much further with less applied energy.

The utilization of the skate-wheel conveyor permits men to be stationed along decks at a distance of fifteen feet apart when moving cargo from the receiving station to the striking zones. Without conveyors, excessive manpower must be used, for each crate or package must be carried individually, a long, tedious and fatiguing procedure. The use of conveyors on a heavy cruiser recently in the Sixth Fleet eliminated by fifty percent the manpower heretofore involved in the replenishment evolution.

Telescopic Aluminum Chutes with Abrasive Retardent Tape

General Description: This chute is evolved in the form of a two-section unit, for "expediting the striking of cargo down ladders and below decks......" Each chute is designed to be assembled in two parts, one section sliding over the other and provision is made to secure these sections at any desired length, thus forming a rigid chute.

Construction: Construction throughout is of aluminum. Steel lashing rings are spaced five feet apart on either side of the guard rail to permit lashing to the ship's ladders.

The bed of the chute is covered with abrasive retardent material in order to decrease excessive speed of the cargo because of the steep inclines of ladders. (Military Specification MIL-D-17951 (SHIPS), 11 June 1954, Deck Covering, Lightweight, Non-Slip, Silicon Carbide particle Coated Fabric, and Beading Sealer).

After usage, the chute can be stowed by simply telescoping it, and lashing it to the reverse side of the ladder. The weight of the assembly is 38 pounds.

Performance: The skillful utilization of the telescopic aluminum chute in conjunction with the aluminum lightweight gravity skate-wheel conveyor demonstrates the ability of such equipment to speed stowage operations considerably, while requiring only a minimum of personnel.

Fig. 55

Showing the start of the cargo flow to the below decks storeroom. Note the lashing rings on the chute.

Fig. 56

Showing the use of the telescopic metal chute. Speed of container is reduced to such an extent that man at bottom readily lifts it off chute and transfers to adjacent sailor at about waist height.

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The Vertical Canvas Baffle Retardent Chute

General Description: This is a chute, fabricated of canvas, with baffle inserts, and designed to facilitate the striking below of cargo through open hatches.

Construction: Fabricated entirely of canvas, the chute can be tailored to suit the particular heights desired, and is constructed in ten-foot sections, which can be hooked together.

The baffles are flat pockets 36" x 36" into which 3/8" plywood is inserted and strapped into place by D-rings and canvas strapping. The weight is nine pounds per lineal foot.

Performance: The principle involved in the operation of the vertical canvas baffle retardent chute is to have the velocity of the falling package retarded through a succession of small drops. The flexibility of the canvas will permit absorption of some of the forces of the impact. The partitions placed alternately within the chute act as baffles to retard the package speed.

Openings are provided along the length of the chute for the insertion of steel delivery chutes at appropriate deck levels. These steel chutes, however, are not always used, their usage is largely dependent upon the working space at the deck level to which a package will fall. A pipe frame holds the chute open at the upper level for proper entry of the containers and provides the means of support.

These chutes have been used successfully on combatant ships at heights of from ten to forty feet.

CDR BABBITT (Gun Factory): I assume that in your vertical lift there you have a limitation of about 100 pounds; is that right?

CDR FULLAM: In this particular one, yes, Commander. But they can be fabricated to meet anything heavier. This particular machine that you saw here is fabricated to lift 150, but in our usage of it at sea in the Mediterranean, we weren't required to lift anything more than 100 pounds.

CDR BABBITT: We're shipping out many boxes, small in size but very heavy, and I've been on the receiving end of those boxes. I wondered what was being developed.

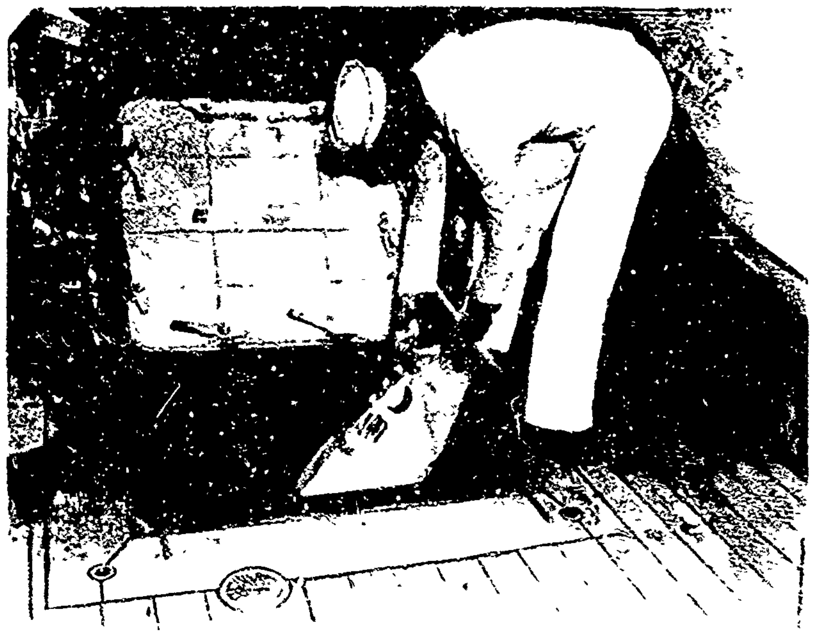


Fig. 57

View showing the use of the vertical canvas chute. Note the method of support; pipe frames inserted through openings at the upper deck level provide the opening and the support. This particular chute discharged four decks below.

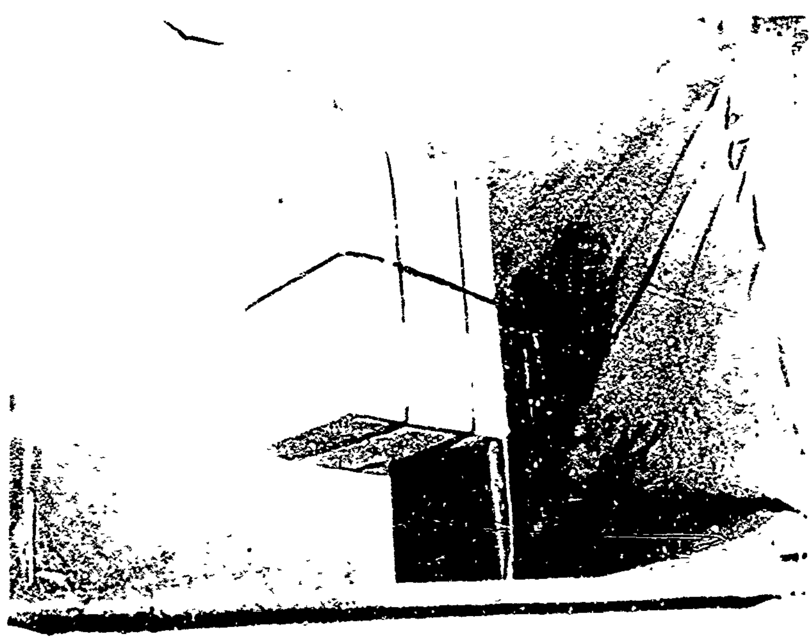


Fig. 58

View of package dropping to the first of a succession of small drops retarding the velocity of the falling package.

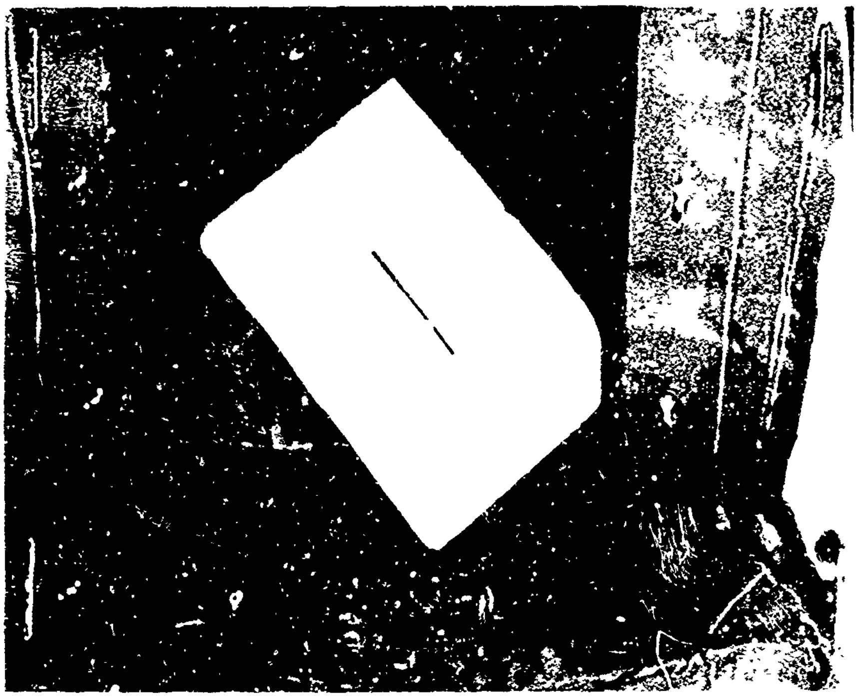


Fig. 59

The discharge point. Note that steel delivery chutes were not in use during this operation.

CDR FULLAM: We develop the machines; BuShips can take it and go on from there. That machine can be fabricated to lift a ton package. We develop the idea. We tell them how; they can tell the fabricators what they want.

CDR BABBITT: Thank you.

MR. TENNYSON (Army Ordnance): On the assumption that significant ship's stores would be portable solids, has thought been given to pneumatic conveyances with flexible tubes from bulk to bulk for such things as flour, wheat, rice, beans, sugar, to be conducted simultaneously with other actions?

CDR FULLAM: Yes, some thought has been given to that.

COL EDSON (Brooklyn Army Terminal): Have you had any experience with domestic pack subsistence in this replenishment program of yours, and if so, what has been the damage experience with the shoots?

CDR FULLAM: Domestic pack, Colonel, doesn't stand up.

COL EDSON: Doesn't?

CDR FULLAM: No, sir. I had hoped to be an observer in this and wound up writing a report on it. Domestic pack doesn't stand up under this handling.

MR. D. C. BROWN (General Services Administration): Does the lack of unitization in the ship's hold — is that explained by the lack of judgment or rolling of the ship that precludes the use of pallet lift or forklift trucks?

CDR FULLAM: We're working now on a forklift to be used at sea, but haven't come up with anything yet that would work in rough weather. I was going to say "impossible" but that's a word I never use — except on the great carriers, the larger ships. They have no trouble at all. Their hangar deck is large enough to warrant that. But a smaller ship which lists 10, 20 to 30°, you can hardly use a fork there.

CAPT FRY: Aren't some ships equipped with fork trucks as, for instance, the USS DIAMOND HEAD? That's under BuShips and BuOrd cognizance.

CDR FULLAM: The discussion here is concerned with AF ships, but the answer to your question is that these are being experimented with at present.

MR. LAYNOR: They're going to be tried in AF's.

CDR FULLAM: We know that. We say they haven't come up with anything yet. The question was, were they being used. I said that in AF ships they were not. I still stand by the answer.

MR. LAYNOR: They're experimenting with them.

CDR FULLAM: Yes, I know they're experimenting and they're going to try them.

CAPT FRY: Let's get back to palletizing the cargo; do they do that?

CDR FULLAM: This has been attempted experimentally, and it is expected that future tests will be conducted shortly.

Panel Session A-2 Wednesday PM Oct. 12, 1955

Vertical Pocket Conveyor

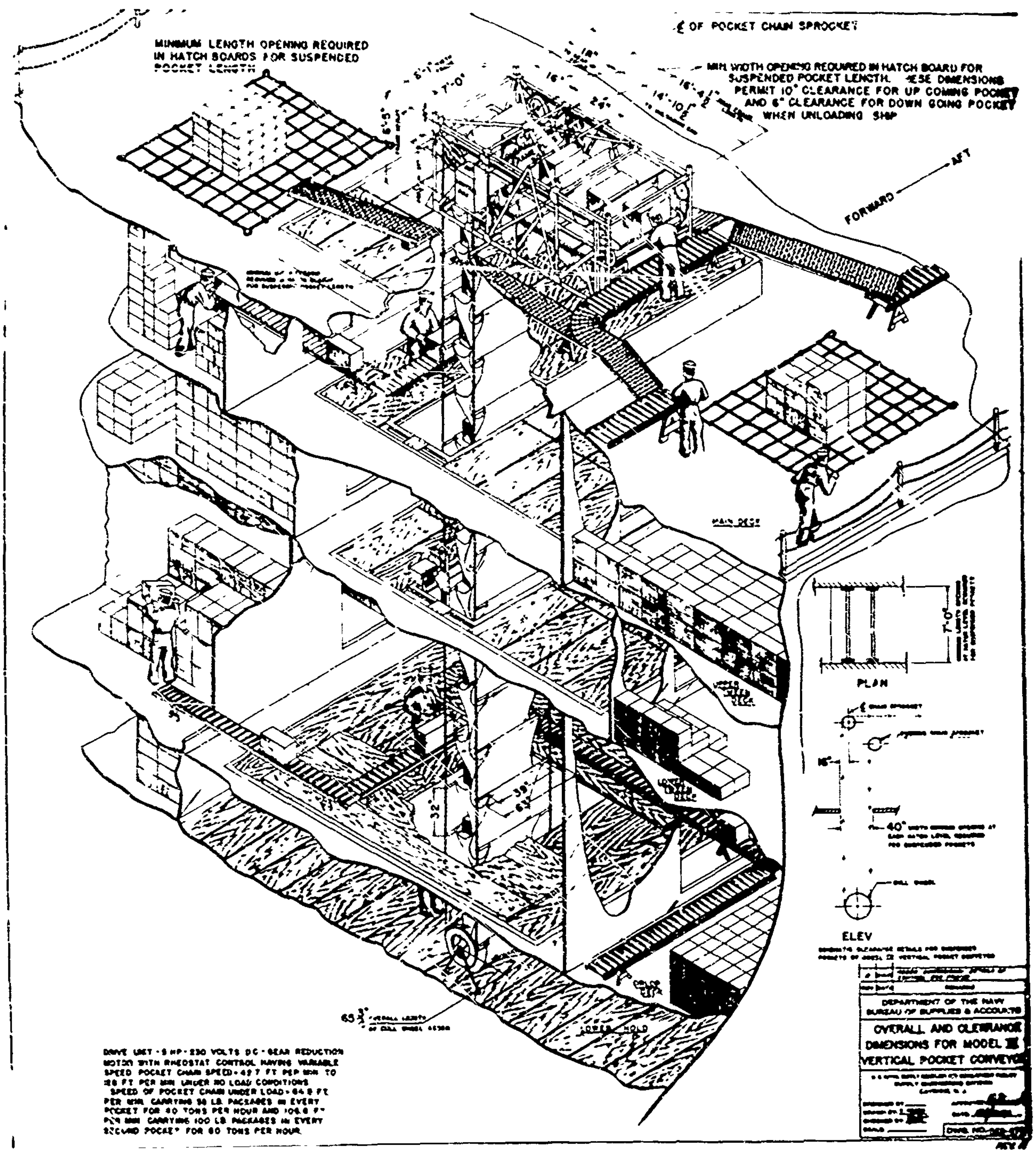
Mr. Chester Heinrich
Chief Engineer, U. S. Naval Supply Research and Development Facility
Bayonne, New Jersey

Under the mobile logistic support concept, which will be used by our Fleets in the time of an emergency, it is vitally necessary that the replenishment at sea of a combat ship from a supply ship be accomplished within the minimum amount of contact time, since ships are more vulnerable to enemy action during such contact. With increased use of the replenishment-at-sea operation, several bottlenecks appeared. One of these was the rate at which cargo nets could be loaded at the various levels within the holds of the supply ship and delivered to the main deck for transfer. The general average rate for such loading is about 18 tons per hatch per hour.

It became apparent it would be advisable to utilize a better method for making the required lift and finally a vertical pocket conveyor was selected as having most promise of meeting necessary requirements, since by such means it was indicated cargo could be moved at a rate of 60 tons per hour.

These vertical conveyors had been previously used by the United Fruit Company in loading and unloading coffee bags and banana stalks, and the original Navy machine was developed from the plans of that company.

A very considerable number of important engineering changes were necessary to adapt the equipment for satisfactory use with Navy containers, however, and these were accomplished by the U. S. Naval Supply Research and Development Facility. Results were proven aboard Navy ships to the extent that orders have been and are being placed to make the conveyors available throughout the Fleet. One of the objectives of showing these slides is to give an idea of representative handling being given to packaging in the Navy. In many cases, the handling you will see is duplicated many times before the packaged contents reach their final use. As a general rule, material used overseas when packaged in accordance with specifications for such overseas use, in V2 or V3 containers, can be expected to arrive at point of use in excellent condition. Domestic packaged containers in such use, however, are usually unsatisfactory. Slides showing operation and use of this equipment are as follows:



MINIMUM LENGTH OPENING REQUIRED IN HATCH BOARDS FOR SUSPENDED POCKET LENGTH
℄ OF POCKET CHAIN SPROCKET
MIN WIDTH OPENING REQUIRED IN HATCH BOARD FOR SUSPENDED POCKET LENGTH. THESE DIMENSIONS PERMIT 10" CLEARANCE FOR UP COMING POCKET AND 6" CLEARANCE FOR DOWN GOING POCKET WHEN UNLOADING SHIP
FORWARD
AFT
MAIN DECK
PLAN
ELEV
LOWER HOLD
DEPARTMENT OF THE NAVY BUREAU OF SUPPLIES & ACCOUNTS
OVERALL AND CLEARANCE DIMENSIONS FOR MODEL III VERTICAL POCKET CONVEYOR
DRIVE UNIT - 5 HP - 230 VOLTS DC - GEAR REDUCTION MOTOR WITH RHEOSTAT CONTROL HAVING VARIABLE SPEED POCKET CHAIN SPEED - 42.7 FT PER MIN TO 128 FT PER MIN UNDER NO LOAD CONDITIONS SPEED OF POCKET CHAIN UNDER LOAD - 64.8 FT PER MIN CARRYING 50 LB PACKAGES IN EVERY POCKET FOR 40 TONS PER HOUR AND 106.6 FT PER MIN CARRYING 100 LB PACKAGES IN EVERY SECOND POCKET FOR 60 TONS PER HOUR

Fig. 60

Fig. 61 - Indicates an installation of a Vertical Pocket Conv [illegible] on the main deck of a Navy supply ship. Neg. No. 288-27.

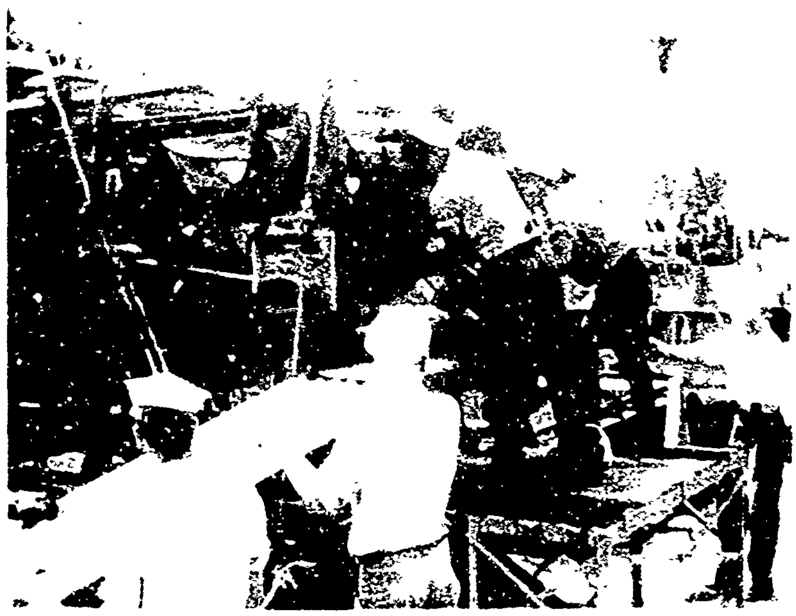


Fig. 62 - Shows the removal of containers from the Vertical Pocket Conveyor. Neg. No. 288-17.

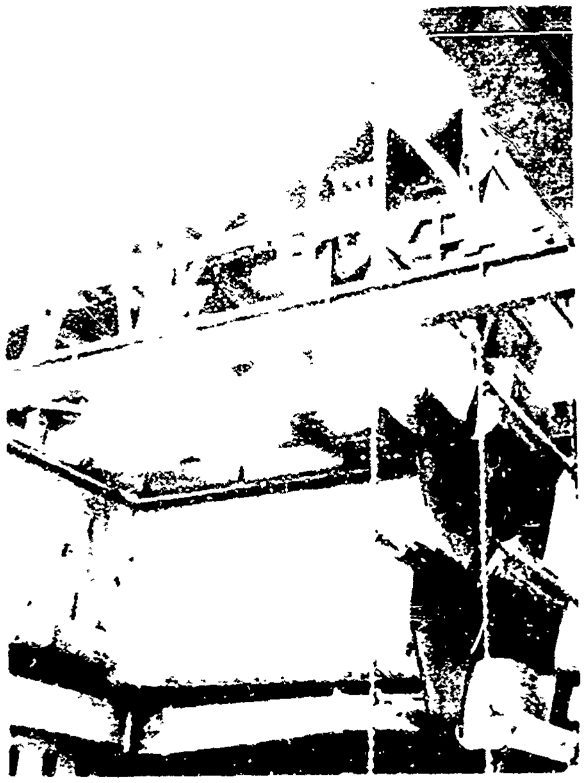


Fig. 63 - Shows how containers are lifted vertically from the hold of the ship, then moved within the machine horizontally to the discharge point. Neg. No. 325-88.

Fig. 64 - Shows the method of moving containers on gravity conveyors within the supply ship's hold by means of gravity conveyors. Neg. No. 325-26.

Fig. 65 - Shows a loading station in the 'tween decks for the Vertical Pocket Conveyor. Neg. No. 325-72.

Fig. 66 - Shows an import transfer of cargo from a supply ship to a destroyer. Cargo containers of provisions are raised from the hold to the deck of the supply ship by means of the pocket conveyor and then moved across the deck and over to the destroyer by means of skate wheel conveyors. Neg. No. 325-2.

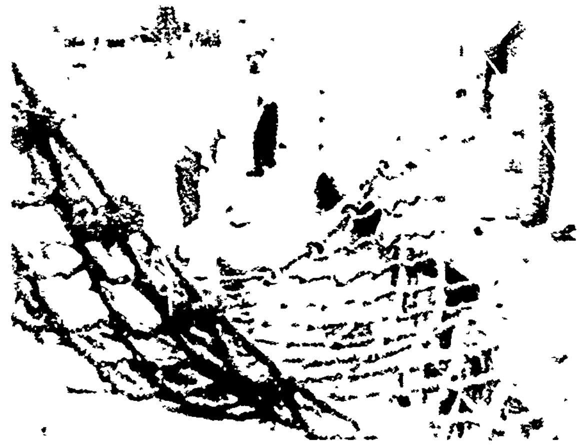


Fig. 67 - Is a continuation of the method of movement shown in the preceding slide. Note use of a chute in the background by which cargo is moved from the upper deck to the main deck of the destroyer and thence to the hatch opening via gravity conveyors for movement to the storerooms. Neg. No. 325-4.

Fig. 68 - Shows movement of a cargo provisions container between supply ship to destroyer. Neg. No. 325-5.

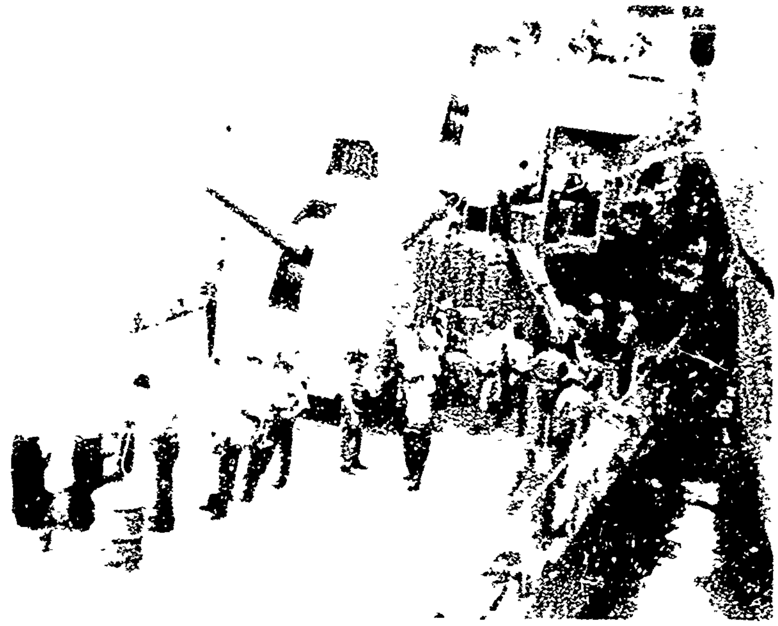


Fig. 69 - Shows movement of supplies to an aft hatch leading to a storeroom on a destroyer. Note the many handlings a container gets before ultimate use. This handling, often abusive, is one of the reasons for adequate packaging specifications. Neg. No. 288-20.

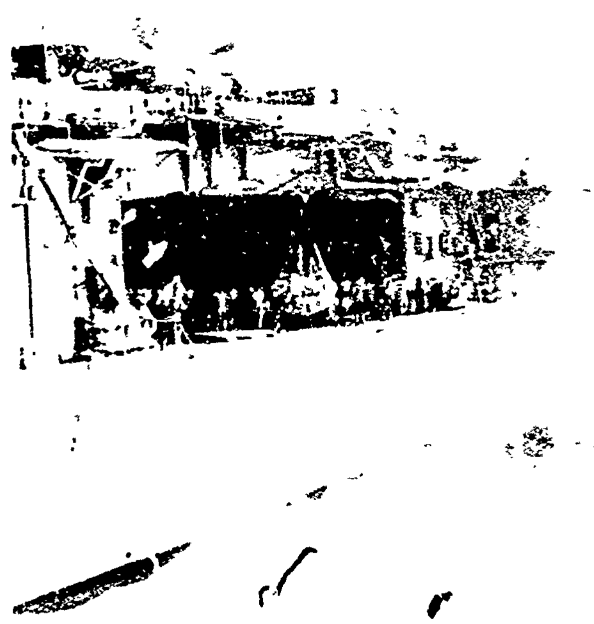


Fig. 70 - Previous slides have shown a transfer of cargo in port. A far greater amount is transferred at sea in cargo nets as illustrated by this slide. This shows a transfer from a supply ship to an aircraft carrier. Such transfers are usually accomplished with distances between ships from 100 to 200 feet. Neg. No. 325-59.

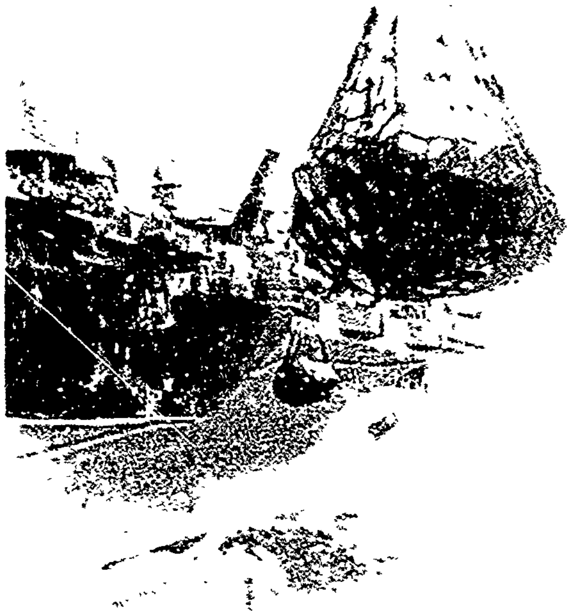


Fig. 71 - Movement of cargo nets to an aircraft carrier during a transfer at sea. Neg. No. 325-49.

Fig. 72 - Slide showing movement of containers from Vertical Pocket Conveyor into cargo net in preparation for transfer at sea. Neg. No. 288-32.

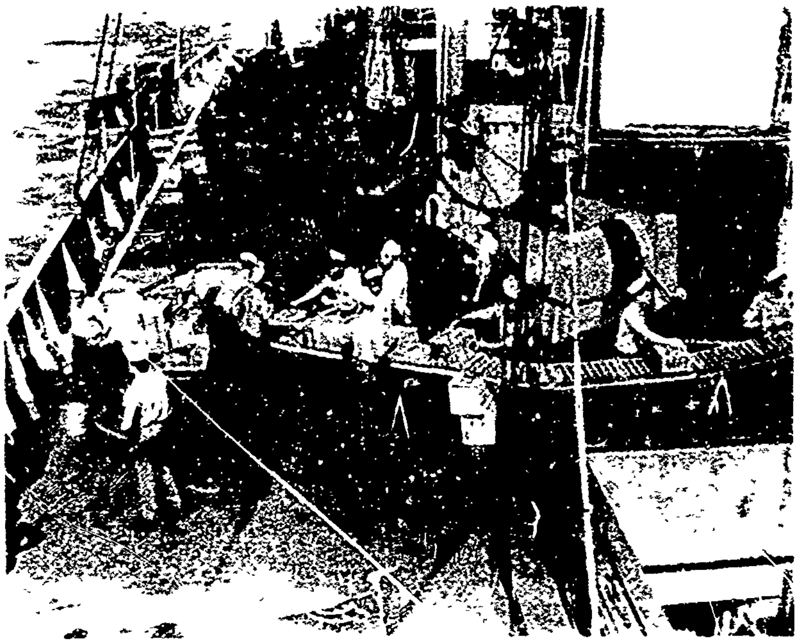


Fig. 73 - Movement of cargo on main deck of supply ship preparatory to transfer at sea. Neg. No. 325-23.

Fig. 74 - Loading of cargo net for transfer at sea to destroyer. Time and manpower do not permit extra care in the handling of containers or bagged goods and indicate necessity for adequate packaging specifications. Neg. No. 288-14.

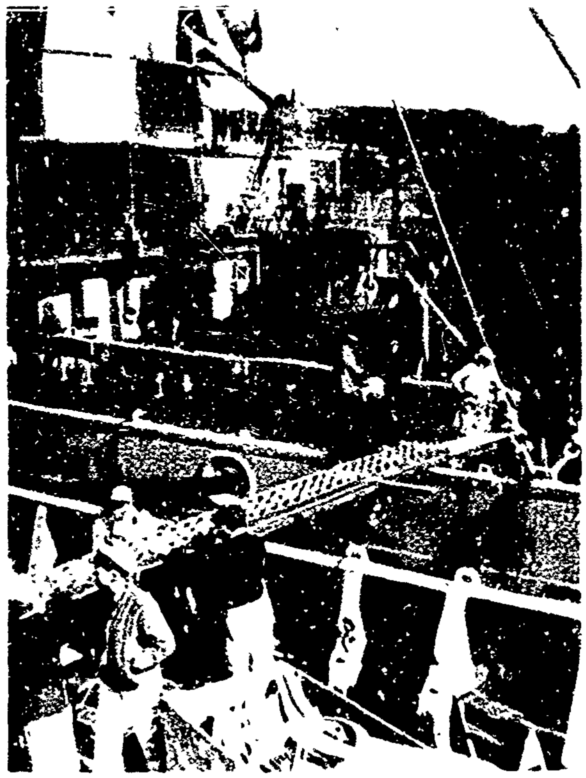


Fig. 75 - Inport replenishment between two supply ships at Yokosuka, Japan, using Japanese indigenous labor. Neg. No. 325-79.

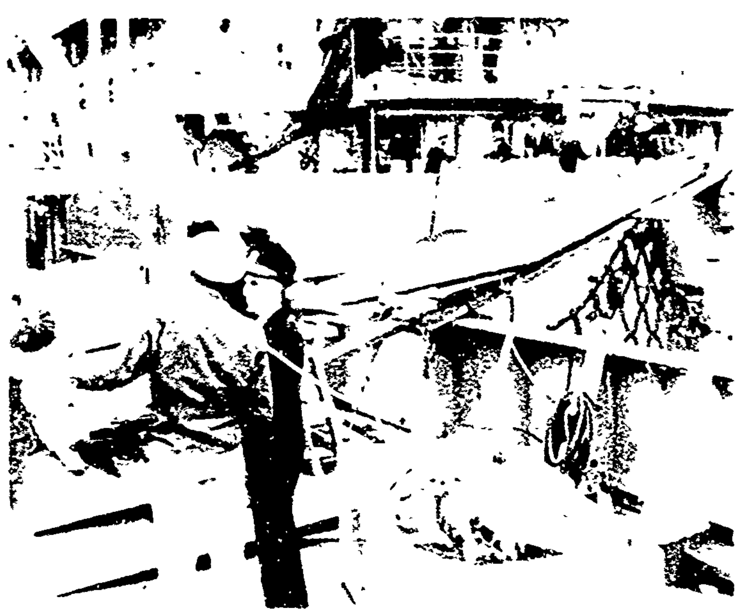


Fig. 76 - Mechanized handling is used during Yokosuka inport replenishment. Neg. No. 325-104.

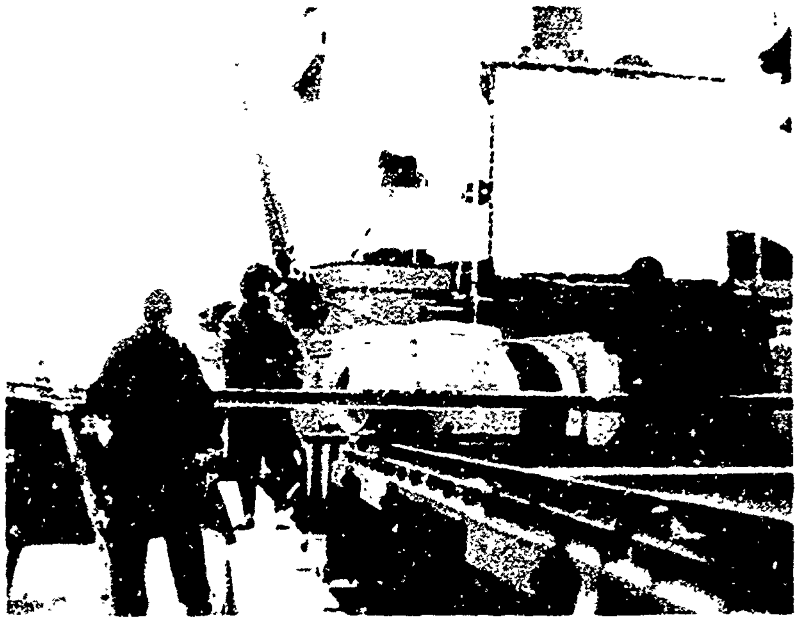


Fig. 77 - Egg crates moved by indigenous Japanese labor overseas. Neg. No. 325-75.

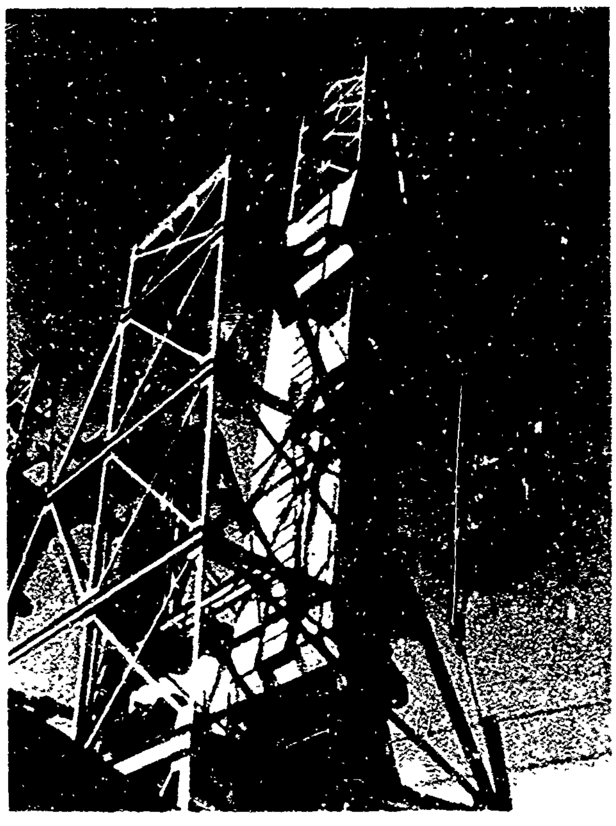


Fig. 78 - View of a pierside Vertical Pocket Conveyor used by the United Fruit Company at San Francisco. This equipment is similar in operation to equipment previously shown in use by Navy at sea. Neg. No. 325-15.

Fig. 79 - Gravity conveyors are also used within storage spaces of a destroyer to move cargo quickly and with minimum manpower. Neg. No. 290-5.

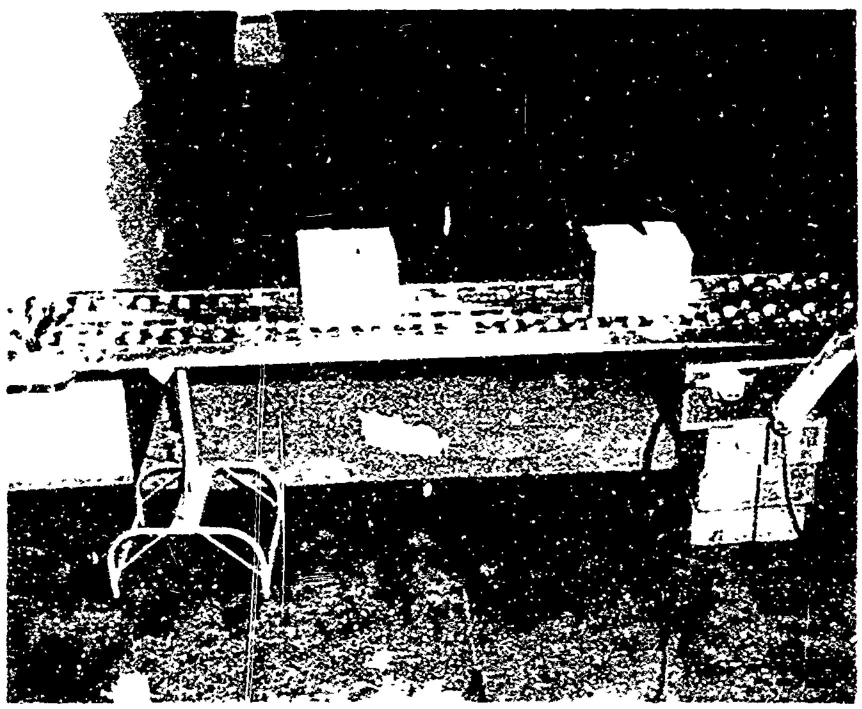


Fig. 80 - New light type power conveyor being developed by the U. S. Naval Supply Research and Development Facility for movement of cargo containers aboard ships. Neg. No. 220-9.

Fig. 81 - Another view of same conveyor shown in previous slide.
Neg. No. 220-10.

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CDR FULLAM: Are there any questions, gentlemen, of Mr. Heinrich's conveyor system?

MR. KUOPPAMAKI, (Naval Ordnance Laboratory, Corona, Calif.): In establishing coordination between these, using these new techniques, what system do you use in establishing criteria, time studies, and so forth, by which you would be able to get the most out of this coordination activity?

MR. HEINRICH: Actually, it's a question of trying to solve the bottlenecks which exist. We have three parts of the replenishment operation. We have a problem of getting material up from the hold of the supply ship to the main deck, the problem of getting it from the main deck of the supply ship to the main deck of the receiving ship, and we have the problem of getting it stowed from the deck of the receiving ship down to the hold.

We tackled the worst bottleneck first, which is raising cargo from the hold of the supply ship to the deck. At the same time we were working concurrently in other directions. For example, the development of the nylon-type cargo net has speeded up the second of those operations so we're getting increased material going across between ships. Also, we are using gravity conveyors, which Commander Fullam will talk about in solving the third part of the operation for stowing material quickly on the combat ship.

We realize there is a definite coordination which has to be achieved. At the present time we are trying to accomplish that by sending Naval Supply Research and Development engineers out to sea both in the Mediterranean and also in the Far East so they can assist directly on the spot in getting a trouble-free operation. It's very important to do that. We also found that with the presence of such a man down in the hold or on the deck of the ship — he can pick up items by observation or personal contact which the sailors develop themselves to speed up the operation. Then you can standardize on the best of these developed under practical conditions. That is what we have been trying to do in addition to initiating the use of improved materials handling equipment.

MR. KUOPPAMAKI: The method of determining the time, is that being standardized?

MR. HEINRICH: We have taken time studies in certain cases. The field is rather new in regard to taking established times. We are progressing in that direction now. But our primary work has been in the development of the machine,

getting it started, getting adaptations installed in the ship. At the present time we only have two of the vertical pocket conveyors in use. But that will be the next step. It is going to be necessary to get industrial engineers down there to make time studies to develop the best methods and techniques of using equipment.

MR. WILLIAMS (Stockton Annex): You mentioned your engineers go below in the hold and possibly can pick up an idea from a sailor. How do you tie that in with the overall Navy Benny Sug program?

MR. HEINRICH: We don't ordinarily tie in, other than to review formal materials handling or packaging suggestions which come before us. Our men, in particular, do not enter into the Benny Sug program because it is a requirement of their job to develop these new ideas. We do not believe it to be ethical for our men to participate within their own field. However, they do come up with a number of suggestions which otherwise would be very valuable to the Benny Sug program. But they are brought into operation in the Navy by means of engineering reports emanating from the Naval Supply Research and Development Facility.

CDR FULLAM: Any further questions, gentlemen?

Wasn't there someone down in that corner?

LCDR HARPER (Alameda): My question was answered by this gentleman back here.

CDR FULLAM: No further questions? Thank you, Mr. Heinrich.

Panel Session A-2 Wednesday AM Oct. 12, 1955

Specialized Equipment for Handling Air Cargo

Mr. B. F. Ryan
Packaging and Materials Handling Division, Director of Transportation
Deputy Chief of Staff, Materiel, Department of the Air Force

During the early part of World War II, I was sent to New Orleans Port of Embarkation where I was assigned as Deputy Officer in charge of wharves. One of the first jobs confronting me was to make disposition of a considerable number of carloads of creosoted piling which had accumulated in the railroad yards and which were continuing to arrive at the rate of about 15 carloads per day.

Previous to my arrival, cars had been unloaded on the land side apron of the wharves by hand. This was, of course, a laborious and expensive operation. When this cargo was loaded aboard ships, it was brought to shipside by dragging one piece at a time through the pier shed by means of a tractor. This was not only time consuming and expensive but it brought all other work in that particular area to a screeching halt while piling was being loaded. Fortunately, we had a number of empty barges and several heavy lift floating derricks available at the time. We also had two marginal tracks on the wharves. We broke the piling bottleneck by unloading the piling direct to the barges a carload at a time. By this method the apparently insurmountable backlog was overcome in three days, and all the earlier confusion of loading piling on board ship was eliminated from the wharves.

I cite this example not because it has any bearing on requirements for specialized equipment but rather to emphasize the fact that, in a great number of cases, no special equipment is needed if our people will use effectively and efficiently the ordinary equipment already on hand. This is a problem in the training of service people which we must face and solve if fast efficient handling of cargo is to be obtained in our many operations. While this training is not a requirement for special equipment, it is a requirement none the less. We might as well junk all the equipment we have, specialized or otherwise, unless we realize that we must train, place and keep qualified personnel in our key operating positions.

Let us assume that we can lick this training requirement and go back again to the waterfront. For at least the last fifty years there has been no appreciable change in the methods of handling cargo being loaded on ocean going vessels. It is brought to shipside by one method or another hooked onto the falls and hoisted aboard. There most of it

comes to rest to be manhandled into place. Many improvements have been made in methods of delivery to shipside and much has been done to speed up the hoisting gear. Equipment now exists that will deliver cargo to rest in the square of the hatch aboard ship at a rate in excess of 100 tons per hour; yet when it arrives there, the rate deminishes to 15 to 20 tons per hour because nothing has been developed to speed this segment of the operation. In my opinion, the handling of air cargo will follow the same pattern unless some drastic action is taken to stop it. Much equipment of various types now exists which will deliver cargo inside the cargo door of an aircraft at a vastly greater rate than it can be moved away, stowed and secured. So you can see the trend is carrying us to the same situation as now exists with waterborne cargo. But airborne cargo business is still in its infancy and a pattern has not yet been set. We can and must see that we avoid the pitfall.

Developing an efficient cargo handling system for loading one particular aircraft is not difficult, particularly if the aircraft is still in the drawing board stage. Then the cargo handling system can be developed as the aircraft is developed. But the problem is not as simple as that. We still have aircraft in our system which were developed during World War II and we probably will have them for some time to come. We still load these and all other aircraft by the "big hands and feet method." In my opinion we are not nearly as much in need of specialized equipment for loading aircraft as we are in need of a handling system: a handling system which is fully integrated and fully coordinated between the services and between the services and commercial industry. The system I have in mind must not consider the one type of aircraft alone or even the mode of air transportation alone. Considerations must be made for a system flexible enough to permit it to be used between such aircraft as the C46 and C54 and the newer type cargo aircraft such as the C119, C123 and C130 which are all approximately truckbed height, tail loading aircraft. Consideration must also be given to the compatibility of the system with other modes of transportation; truck and rail. Seldon is a shipment made from producer to consumer by air alone. Usually truck, rail or both are involved along with the air movement. We must also consider that our reserve airlift for emergencies is backlogged in our commercial air fleet. Any rapid cargo handling system that is evolved must be compatible with the type of aircraft we will get from commercial operators in an emergency.

I do not believe that there exists at the present time a requirement for any specialized equipment for handling air

cargo outside the aircraft. Our bottle neck is within the airplane. In order to break this bottleneck, we must develop a system of getting our cargo in larger packages or in unit loads which are prepared before the aircraft is ready to load. These unit loads can be handled quickly and efficiently inside the aircraft by means of pallet jacks, rollers or tracks. Because of our need of flexibility and mobility, any equipment that we decide to use must be as light as possible and, of course, air transportable. The system we adopt must be completely compatible with all current types of aircraft employed for cargo movement as well as with other modes of transportation. The system we adopt must be capable of efficient application to future cargo carrying aircraft, both those developed for military use as well as those developed for commercial use.

The development of a system as mentioned above can have a significant effect on the design of cargo aircraft of the future and could standardize those used by commercial sources.

In any event, let it not be said by writers on this subject in the future, that we let ourselves become burdened with systems of handling air cargo which tended to dissipate to a large degree the advantages of speed and flexibility of air shipment.

CDR FULLAM: Thank you, Mr. Ryan — Gentlemen, are there any questions regarding Mr. Ryan's discussion?

MR. HOWARD (Sandia Corporation, Albuquerque, N. M.): In case of units which are technically larger than the pallet you mentioned, do you intend to have any sort of standardized system in that case?

MR. RYAN: Well, I should have touched on that. We figure that roughly 50 percent of our airlift going overseas will fit the unit load system. I should have mentioned that for special weapons, for engines, and outsized pieces of equipment like that that there is definitely a necessity for specialized equipment.

Now, being at Sandia, I know that on some of these larger weapons that we have that materials handling equipment has been developed concurrently with the development of the weapon. There is concurrently, presently, a lot of work going on in developing dollies for engines, and we hope that in the future as the new aircraft engines are developed, that the materials — handling of specialized dollies — or whatever is needed, will be developed as the weapon or the engine is developed. Does that answer your question?

MR. HOWARD: Yes, thank you.

CDR FULLAM: Any further questions, gentlemen, to Mr. Ryan?

MR. BERGER (Quartermasters Corps, U. S. Army): In talking about this 40 by 48 size, there is an attempt being made by ASA to coordinate the standardization of pallets. Do you propose that the dimensions shall be a combination of 48 or 40? In other words, 80 by 96, or one dimension is to be 40 inches, or one dimension be 48. In other words, shall it fit a pattern of 40 or a combination of 48 and a —

MR. RYAN: A combination, that is right.

MR. BERGER: But it does not have to be the same proportion.

MR. RYAN: That is true; I mean, that is in the development of the system. That is exactly what I had in mind — Any other questions?

(There were no more questions.)

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Panel Session A-2 Wednesday AM Oct. 12, 1955

Transportation Corps Beach Lighterage Fleet

Mr. Henry A. Snell
Transportation Corps, Department of the Army

Since the close of World War II, and particularly since the beginning of hostilities in Korea, the Transportation Corps has intensified its efforts to increase the efficiency of ship-to-beach cargo discharge operations. The realization that the use of mass destruction weapons in future warfare will, in all probability, deny us the use of many conventional port facilities has hastened these efforts.

Basically the efficiency of a ship-to-beach cargo operation may be increased by improvement in any of the three primary components of such operation, namely: Organizational Structures, Operating Techniques, or Equipment. These remarks will be confined to the latter category and more specifically to our various types of lighterage.

Beach lighterage equipment may be devided into two classes: Landing craft and Amphibious vehicles. The Transportation Corps uses both types extensively.

The principal Army landing craft - the LCM-6 - has changed little from its World War II predecessor. It is a bow-ramp boat, 56 feet long with a cargo capacity of 30 tons. In reference to capacity of a lighter, it should be pointed out that figures stated are the theoretical maximums and that loads of such magnitude can not usually be obtained in actual practice because of space limitations. The LCM-6 is a versatile craft, and is used by the Transportation Corps both for handling general cargo and small to medium sized vehicles. It is particularly well adapted to handling packaged loads, such as cargo transporters, or pallets. The LCM-6 is also used to a considerable extent as a non-tactical personnel lighter and if required, to land equipment and personnel in assault. The craft has a speed of about 7 knots loaded.

Recently a new landing craft designated LCM-8 has been designed and procured for Transportation Corps use. This craft was conceived as a beaching lighter capable of handling any vehicular lift organic to an infantry division. Its 48-foot long cargo well with a ramp opening of over 14 feet will accommodate a D-8 bulldozer with blades, for example. The craft's cargo capacity of 60 tons was established to enable it to handle heavy tanks of that weight. The LCM-8 has more horsepower per displacement ton than any other of our landing craft. It has an additional advantage over the LCM-6 in that

the cargo well is self-bailing. We have found from operational experience that the high degree of maneuvrability and power of this craft make it particularly well adapted to handling at ship-side. The LCM-8 is the fastest of our lighterage units - top speed loaded is 11 knots.

The largest of the Transportation Corps landing craft is the LCU, latest design of which is designated 1466 class. This craft is well adapted to handling outsized heavy lifts and vehicular loads. General cargo can be handled efficiently if palletized or containerized. The LCU is sufficiently large and has generator capacity for the operation of navigational aids, such as radar, etc. Hence, it can be used under conditions of visibility which might otherwise preclude lighterage operations. It is interesting to note that the older LCU-M6 is the only landing craft capable of bringing the 280 mm atomic gun to beach. We have actually performed this operation on several occasions. Consideration is now being given to a redesign of the LCU. The object of this action will be to increase its seaworthiness to the extent that it is self-deliverable overseas.

The interest recently displayed in roll-on-roll-off ship discharge has caused the Transportation Corps to investigate the use of a large beaching lighter for this purpose. The design of what is known as the 300-foot beach lighter has been completed and construction of the first prototype is expected to begin this winter. This vessel will be employed to receive vehicular loads by ramp discharge from specially constructed deep-draft shipping. It will then proceed to beach and discharge by use of its own ramp. The beach lighter has an overall length of 331 feet and a 65-foot beam. To give the vessel good maneuvrability and stability in the surf zone cycloidal propulsion is employed.

It was not until World War II was well advanced, that the inherent advantages of amphibious vehicles became widely known. When it became established that their ability to cross offshore obstructions, operate independently of tidal condition, and deliver cargo directly from ship-to-dump without shoreline transfer could well revolutionize beach operations, the Truck, Amphibious, 2½ ton, 6 x 6 - the WWII DUKW - was placed in mass production. We are still using this vehicle although all units now in service are at least 9 years old. As you know the DUKW is a seagoing version of the 6 x 6 Truck. Cargo capacity is 2½ tons under average conditions. The DUKW is very well adapted to handling net drafts of general cargo, drummed POL, ammunition and the like. It can not handle heavy or bulky loads. Its principal disadvantage is

its slow water speed - 6 mph. As is characteristic of amphibious vehicles, the DUKW has superior tolerance to surf and can operate safely through breaker heights that would present extreme hazards to landing craft.

During the Korean action, the design of a replacement vehicle for the WWII DUKW was undertaken. Several of these vehicles - named Superduck - have been constructed, tested, modified and retested. This work has been conducted by Ordnance with Transportation Corps coordinating. We feel that the design is about finalized and expect a production model vehicle in a few months.

Although still rated at $2\frac{1}{2}$ tons the Superduck has a larger cargo space and somewhat greater capacity than its predecessor in reality 4 tons. Water speed is 7.5 mph. The vehicle will handle the new 110 mm gun howitzer. It has improved conditions of free-board and during tests has demonstrated an excellent ability to go through surf. The vehicle now has a steerable propeller incorporated in its design. We believe that this will overcome the rather poor water steering characteristics of the old DUKW.

About four years ago, the Transportation Corps started work on the design of the 60-ton Barge, Amphibious, Resupply, Cargo, BARC. The objective of this project was to achieve an amphibian capable of transporting large vehicular loads. The cargo well was designed around the 60-ton tank. Four prototypes of the BARC were fabricated initially and extensively tested. All four vehicles are currently engaged in beach support operations in the theater of the North East Air Command. The BARC has given us the capability of operating independently of the shoreline where before at least a portion of our operations were pinned to the water's edge. This ability to move heavy lifts directly from ship to some inland point will facilitate the dispersal of our operations to a considerable degree. The vehicle is about 63 feet long by 27 feet wide and has a weight of 97 short tons. The BARC is transported overseas either in an LSD well deck or deck loaded on conventional shipping. When heavy lift cranes are not available to unload the BARC it can be launched directly from the vessel's deck on specially constructed ways. We have done considerable testing of this technique.

A third new wheeled amphibious vehicle is currently under development, the Truck, Amphibious, 8 - 10 ton, 8 x 8, DRAKE. In the design of this vehicle more attention has been attached to marine characteristics than is ordinarily the case. Its comparatively smooth lines, length and power indicate

that we may achieve a water speed of around 10 mph. This is an excellent speed for an amphibian and compares very favorably with landing craft. The DRAKE has a rear tail gate to permit ready unloading of vehicular loads. It can transport the 155 mm horwitzer or 6 x 6 truck. This represents our first attempt to use aluminum in an amphibian. The DRAKE has a welded aluminum hull. It is estimated that the DRAKE will weigh a little over 13 tons. Three (3) prototype vehicles are presently being constructed. We expect delivery of the first in November.

This concludes the items of our present lighterage fleet and the new designs which we hope to soon put in operation. We are, however, investigating improvements from a long range standpoint. For example, Ordnance has a company under contract for the development of a wheeled amphibian with a 25 mph. water speed. It may develop, after obtaining operational data on the DRAKE, that there is a requirement for a vehicle intermediate in capacity between it and the BARC. As in other fields, lighterage must change to keep pace with changes in other military equipment and doctrine.

MR. SNELL: Do you have any questions?

(There were no questions.)

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Lieutenant Colonel E. J. Cullinan
Transportation Corps, Department of the Army

As Colonel Maidt brought out in the beach movement of cargo, the Transportation Corps found itself with a definite problem during World War II and the years following that.

So when it became apparent that the new concepts of war were going to undoubtedly force us to move our cargo across the beaches and through undeveloped ports, the Army Transportation Corps took a sharp look at old World War II equipment to determine first the capability of operating small dispersed ports and second, potential ability to move large quantities of cargo across undeveloped beaches. Third, these organizations had to have a structural capability of breaking down into small units and being able to operate efficiently.

Then we had to find out what organizational changes were immediately needed to accomplish these facts. Our old World War II port organizations were looked at and they were found sadly wanting to accomplish this movement of cargo through these questionable areas. They were almost incapable of efficiently breaking down into smaller units. They had no equipment that could efficiently move cargo across the beach and unfortunately our units that were trained to discharge a ship equipment-wise could t have moved a pound of cargo across the beach unless ey carried it on their backs.

So we had not only t revamp our organizations, but we had to immediately get to work and change our equipment. Now this dual Transportation Corps responsibility of developing equipment and organizations capable of proper usage from a waterborne carrier to initial land based storage points has been aggressively pursued since the end of World War II.

Equipment-wise, for beach operations, the Transportation Corps concepts are designed to give logistic resupport of operations over unimproved terrain and to accomplish efficiently this operation in consonnance with accepted criteria.

The basic equipment provided the terminal service companies that replaced our old port organizations are the rough terrain and fork lifts and rough terrain cranes.

May we have the first slide, please?

This is the 6000-pound rough terrain fork lift. It has a capacity of 24-inch load center of 6000 pounds. It has a

turning radius of 15 feet. It has a lift of 144 inches and the forks can go to 45° forward; 30° to the rear; and 10° both sides. It has an ability of a 45° slope and can move 20 miles an hour. It can move over obstacles of 14 inches of maximum height. It has four-wheel drive and steering with low pressure tires.

There's very little difference in this next one, the 10,000-pound fork lift. It has a 24-inch load center, 10,000-pound weight, turning radius 17 feet. It has the same lift of 6000 pounds, 144 inches, 45° tilt and the same speed of 20 miles an hour. However, this does not have four-wheel steering, a characteristic we hope to overcome in the future. This piece of equipment hasn't met all the points that we want. We've had to revamp it several times. However, it has been type classified. We are purchasing 27 of them in the near future — rather the Navy will purchase them for us. I believe the contract will be complete soon. We hope by the time we wear out the 27 between the Quartermaster Corps and the Transportation Corps that we will have corrected the faults we found in this piece of equipment.

The second piece of equipment we have is the rough terrain crane. Now as a prime user of mobile cargo handling cranes, Transportation Corps has been confronted with many operating difficulties, such as operating over the beach at undeveloped areas, and the need for dispersal of port facilities. We developed a requirement for this instrument that will move over beaches without tearing them up; operate in water without tipping over, such as tracked cranes have shown themselves to do. Also, the cranes we have been using to date for lifting cargo were designed for hauling dirt or for shovels that the engineers developed for their own use. We've had to apply them to our own use. This is the first real cargo crane we've used.

It's a question, as earlier studies have indicated to us, that wide based pneumatic tire mounts have provided greater mobility for beach conditions than conventional track. We are testing this 15-ton crane at Fort Eustis now. We've had it with the Engineers at Fort Belvoir. It has not yet been accepted as a final end item. In addition to the mobile cargo piece of equipment we have developed a beach conveyor similar to this, as shown.

This is an over-land conveyor. The other thing there is a lighter piece of equipment that six men can carry and run up to the beach and you can move small pieces of cargo out of LCM's or barges that come ashore. That would tie into the over-land conveyor here (indicating). This piece of

equipment is still under test at Camp Wallace, which is attached to Fort Eustis, Virginia.

I'd be amiss if I didn't bring out our little jewel here. I wish I could have the other slide first on that. This is an aerial tramway. It's a combination of spud barges and civilian type cables that would pick up cargo discharged onto the spud barges and carried half a mile inland. They are 5000 feet long, and you usually find them half in the water and half overland. Cars run back and forth on these wires. They are capable of carrying 10 tons. The unfortunate part of this piece of equipment is that it's strictly a one-way traffic thing. We found that by shuttling our cars that are self-propelled, bringing them half way, and having them come half way from the other side in this manner (indicating), we have been able to increase our capability.

We have now underway work to develope a circular track at the other end so we don't have to bother about this particular piece of equipment here. This tramway is established at Mulberry Island, Fort Eustis. The Transportation Corps and the Corps of Engineers are now erecting a second tramway at Little Creek, Virginia, with the cooperation of the Navy. That will be in operation probably around the first week in November.

I will now entertain any questions on the equipment.

CDR FULLAM: Any questions for Colonel Cullinan?

MR. P. C. WILLIAMS (Naval Supply Annex, Stockton, Calif.): I notice on that 15,000-pound forklift, one that you showed there first, is there any stabilizer in that boom to stabilize the load in case you hit this rough terrain whereby the load itself won't tip?

CDR FULLAM: The question is, is there a stabilizer in the boom.

LTCOL CULLINAN: Not this particular one. That, by the way, was a 6000-pound forklift. The 15,000-pound forklift we are holding in abeyance until the Quartermaster Corps and the Transportation Corps make a further study.

CDR FULLAM: Are there any further questions, gentlemen?

(There were no further questions.)

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Colonel Honald N. Maidt
Transportation Research and Development Command, Department of the Army

Gentlemen: Commander Fullam has been after me for several weeks to prepare a paper, which I refused to do. The reason for my refusal was that the subject was, "Materials Handling Equipment which had been Developed for Specific Military Uses." Even though I am vitally interested in this field, there are other representatives who are going to cover this area. I, as a member of Transportation Research and Development, have a primary interest in the field of equipment which has not yet been developed. So, because of the nature of the problem, I came this morning not so much to tell you what we have; but rather I came to learn what you have.

To establish the reason for the military interest in improving Materials Handling, I should like to quote Field Marshal Lord Wavell. He said, "The more I see of war, the more I realize it all depends on administration and transportation. It takes little skill or imagination to see where you would like your army to be and when. It takes much more knowledge and hard work to know where you can place your forces and whether you can maintain them there. A real knowledge of supply and movement factors must be the basis of every leader's plan." These are the words of Field Marshal Lord Wavell, who is recognized by history as a great military leader; and it is significant that a military leader of his caliber should recognize the problems of, "where you can place your forces" and, "whether you can maintain them there." In the movement and handling of cargo, studies have been made by the Transportation Corps; and these studies reveal that the World War II methods of handling heterogeneous odds and ends, that is, cargo in small lots, particularly in the off-ship unloading and the over-the-beach handling phases, requires 1.65 manhours per long ton to move the cargo ashore and inland. Further studies indicate that, by palletizing, you could do the same operation for about .85 manhours per long ton. Further, by adopting containerization, this same cargo handling phase is reduced to .6 manhours per long ton. Realizing that the prime subject today is materials handling and not unitization, I develop this fact in order to establish that we need better materials handling if we are to realize the inherent benefits of handling the homogeneous larger packages. One of the most critical areas in the handling of these larger units is in the area of handling cargo weights of the nature of three to eight thousand pounds (3-8,000 lbs.) in the holds of a ship. For the movement from

1 of 2

the square of the hatch into the wings, or the reverse movement into the square of the hatch, there is today no satisfactory materials handling equipment. In the other area — that is the one over-the-beach where cargo must be handled again — a piece of materials handling equipment such as a Rough Terrain Forklift is a must. With reference to the terminology "forklift," I should like to make clear that I do not care whether you call it a forklift, which is roadable, or whether you call it a self-loading, self-discharging truck. The essence of the problem is that we need something which will handle cargo over the berm of the beach and carry it inland three to four (3-4) miles, at a speed competitive with highway transportation; in order that we may clear the beach of congestion at the waterline. This same vehicle must be capable of operation in shallow water, in order that it can go in and get its load, and come out from whatever type of landing craft or portable piers we may be utilizing in the beach discharge. It also means operation over an infinite variety of soils. Of course, we normally think of a beach as being soft sand; and that is a definite problem in itself. At this point we do not have rough terrain forklift equipment which is satisfactory to meet the military requirement. There are other types of materials handling equipment in which people are interested. Examples are aerial cableways and continuous conveyor systems, and the multitudes of variations within these main types.

I am here today because of our intense interest in what you in industry may have that we do not know about, or ideas which you may be able to develop, which will be of considerable help to us in these major problem areas. Again, I say, I am here to learn from you, rather than to tell you what we have done.

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Mr. Joseph Akrep
Supply Research and Development Facility, Department of the Navy
Bayonne, New Jersey

Gentlemen, I hope you will bear with me with my cold. I think this is a good room, and I should be able to make myself heard, especially since I have mostly slides to show for my talk.

I have just a few introductory comments, and then I will go to the slides. For illustration of my discussion on cube utilization, you will notice these wall charts. They are selection charts which we have developed on improved cube utilization. The factor we have considered is the actual cube which has been utilized out of that which is available in setting up the unit load, and this is the particular problem on which we have been working, and on which we wish to report.

Since the warehousing systems of the services are so large, even a small gain percentage-wise would add up to very satisfactory saving. As an example, in one bureau, the available covered storage space is approximately 300 million cubic feet, and each percent gain is 3 million cubic feet of space, worth two or three million dollars a year. That is quite a bit of money. In some specific instances, say, a particular size of box, or a particular item, it may be possible to save up to 10 or 15 percent right on the pallet itself by changing the pallet pattern or the container size.

In a solution of this general problem of pallet pattern and container size selection, many methods are available commercially and in the services. However, these methods had serious shortcomings due to the very large amount of data that is involved in all the comparative dimensions, areas, and efficiencies, and did not permit any easy selection or comparison on either the pallet pattern or the container size basis.

For our purposes, we were able to devise a new method of handling this mass of data in a manner which eliminated the deficiencies of the previous methods. This resulted in a pallet pattern selection chart, which is illustrated in Figure 82. You can't see very much of the detail, however, I want to give you a rough idea of the method of layout. There is one axis for width and one axis for length, and we have the small areas outlined. The important point is that we have on a chart, (a single chart, something you can put on

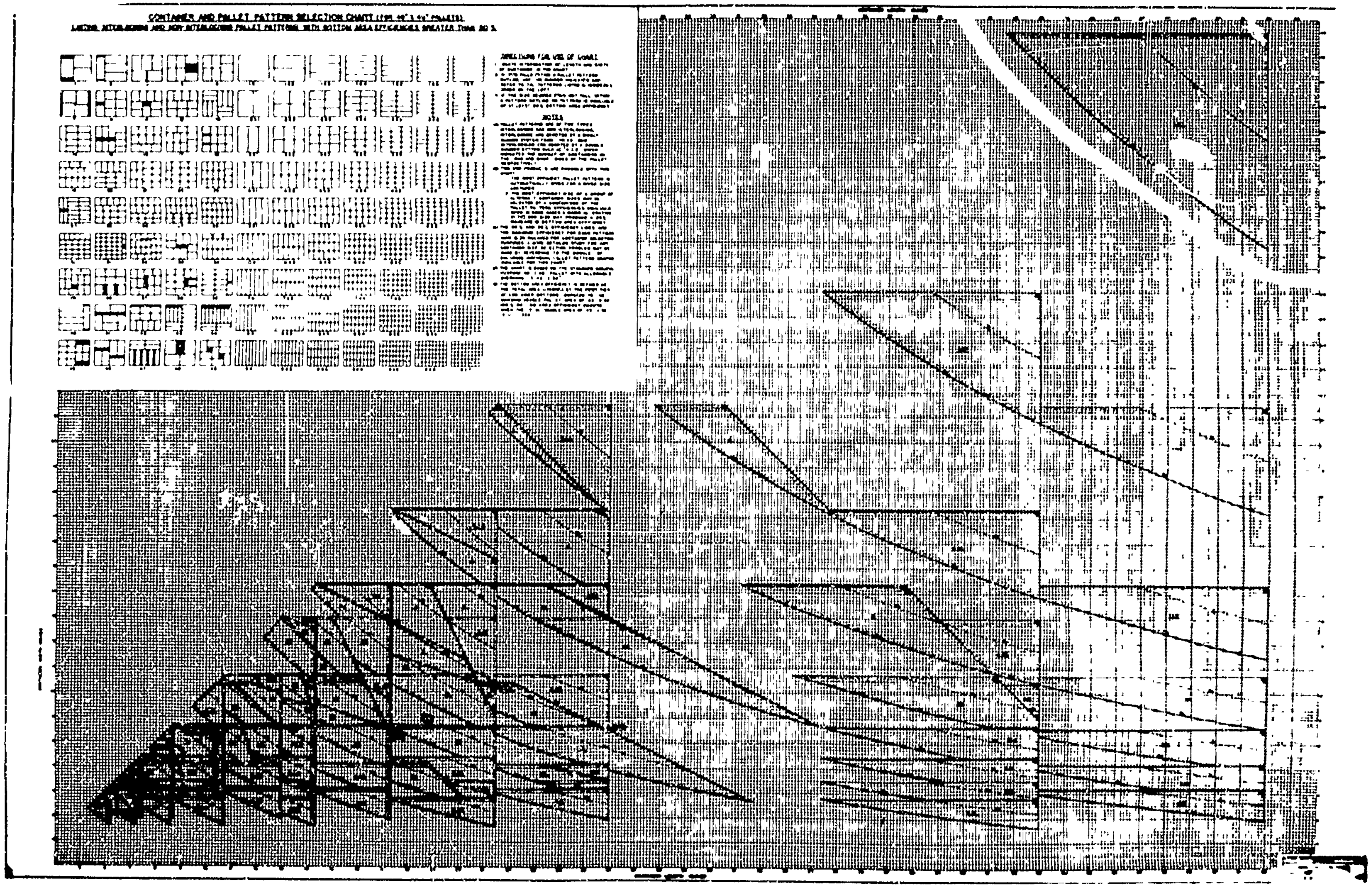


Fig. 82 - Original full size selection chart. Drawing No. S&D-SK-506 Neg. No. 348-16

the wall,) a method by which you can select a pallet pattern. Now, the small areas that are shown are the areas in which that numbered pallet pattern, which is illustrated on the upper left, will give over 80 percent efficiency.

Now, the thing to do is to pick out your width — and pick out your length. This locates a point on the graph, and if we have a pallet pattern that is over 80 percent efficient, you will be within a number area. Locating this number in the legend on the upper left will give a sketch of the pallet pattern that we have found. On this particular chart, we have laid out the 80, 90 and 100 percent lines, where 100 percent is applicable, or the maximum. We found that the pallet patterns in these areas so overlapped to the extent that we kept eliminating the least efficient patterns in definite size groups, and kept getting better patterns all the time.

Now, it is important to note, right at the beginning, that this is a 40" by 48" pallet in which we are very much interested. This is a standard general purpose pallet on which the services have standardized. Since most of the 50 or 60 million pallets in the services at the present time for general warehousing are 40" by 48", we have conducted this analysis for that particular size.

In addition, we have an allowable overhang of one and a half inches on the narrow dimension, and two inches on the long dimension, so actually these patterns are laid out for the 40" by 48" pallet enlarged to 43" by 52". The advantage, as far as we are concerned, in this kind of a chart is that we can select the best pallet pattern by locating the length and width on the chart, and then, if we have a choice we can select the best container when several different sizes of containers are possible. There are many items that can be packaged in a range of container sizes. For any particular item, you may select a container size that will come out at 80 percent; one at 90 percent; and still another at 95 percent. The answer is obvious, of course. All other things being equal, we must adopt the size with the best efficiency.

We hope these charts will be an aid in standardization, since, of course, there are literally thousands of box sizes. You can order any size container you want, and you can find any size. However, to attempt to pick one out as the most efficient, it would be necessary to compare it with an enormous amount of other sizes. That is our big advantage in this particular chart. We hope that some form of this chart, or the chart itself, will eventually get into procurement as

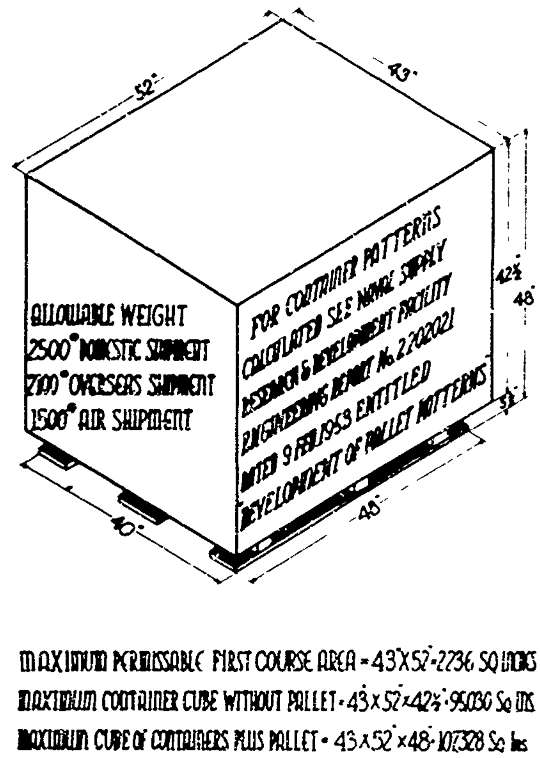


Fig. 83 - Basic pallet unit load cube outline 43" x 52" x 48"
Neg. No. 348-14.

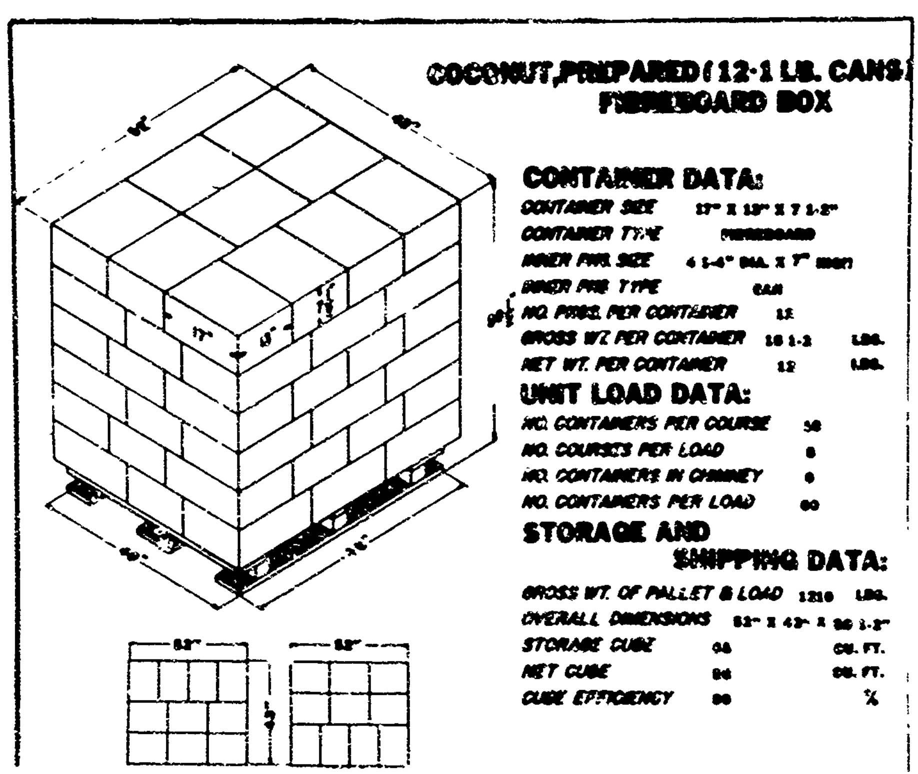


Fig. 84 - Sample page from Navy Department, Bureau of Supplies and Accounts Publication No. 269 "Pallet Patterns - Dry Provisions" Neg. No. 308-9.

an aid for container size selection in procurement. In other words, we wish to start right at the beginning of the production line and get an efficient size of container, or if it is palletized at the production plant to have an initially efficient pallet pattern. We are interested in the best efficiency we can get on the first handling without the necessity for further repalletizing or repackaging once the package is in the Supply System.

Figure no. 83 illustrates the scope of our work, and all our charts are based on these statistics since they set up our boundary conditions. You will note that we have the 40" by 48" along the bottom, while along the top we indicate the overall width and length we will allow. This comes out to be 43" by 52" with the allowable over hang. Those combinations have been set up as representative of the spaces which are available in railroad cars and trucks. They will fit the long dimension twice across the width of a railroad car, and the narrow dimension twice across the width of a truck. While we are eventually interested in filling a cube as much as possible, the height isn't too important at the moment since we are primarily interested in the bottom area utilized for the purpose of this talk.

Figure no. 84 is an example of a page from the Pallet Pattern Handbook, of which I have a sample here. This was made up specifically to palletize 44 different items of dry provisions which occurred in the military services in large enough volume to warrant palletization.

There are some specific items of interest illustrated. For instance, you will notice the voids in that pallet pattern as laid out for this particular size. There is nothing we have been able to do about it, however, if we can avoid the loss, we would wish to do so. This page also gives a pallet pattern layout for the help of the warehouseman who is using this handbook. On the side is tabulated a list of data which gives details of different sizes, percentages, and many other items. However, it is important to note that this type of presentation is good for only one specific size.

In particular, one of the limitations of this book is the fact that we can only use it for the specific sizes of the dry provisions listed.

Figure no. 85 is the back page of the handbook and covers the patterns which were used. You will notice it is quite limited, since its 30 patterns cover only the particular items that we have in this Pallet Pattern Handbook. One

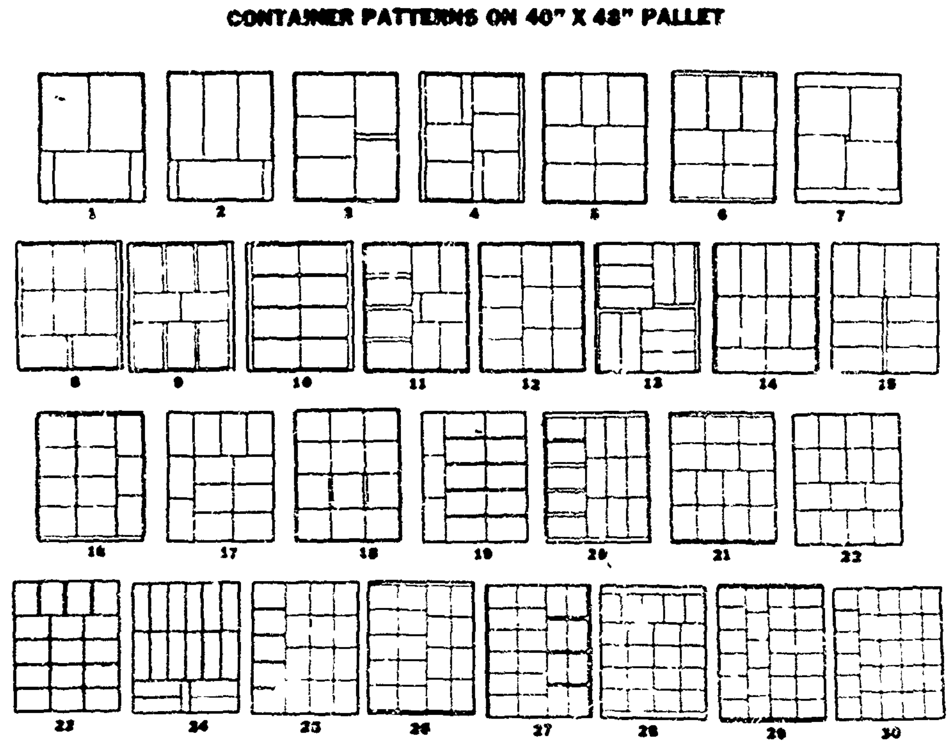


Fig. 85 - Pictorial chart from Pallet Pattern Manual NAVSANDA No. 269. Neg. No. 308-11.

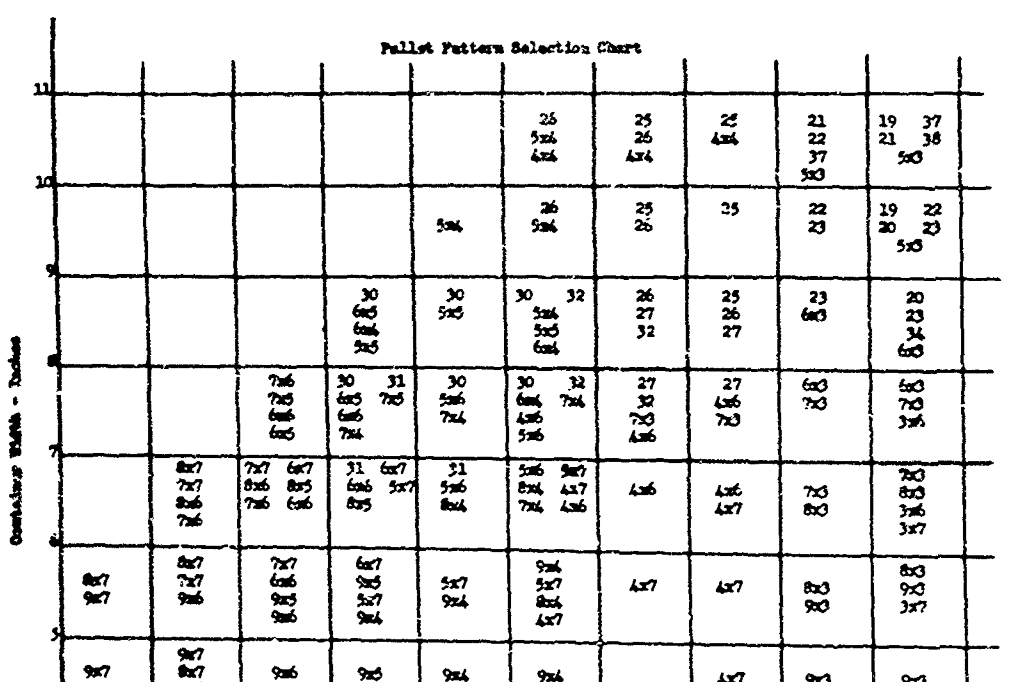


Fig. 86 - Coordinate chart for pallet pattern selection. Neg. No. 348-11.

Container Size Overall Dimensions Inches L	W	H	Container First Course Area Efficiency %	Container Pattern Cube Efficiency %	Container Pattern Plus Pallet Cube Efficiency %	Void Cube Loss %	Container Pattern Cube Cu. In.	Total Container Cube Cu. In.	Void Cube Loss Cu. In.	Container First Course Area Sq. In.	Pattern No.
17	13	14½	99.2	67.4	59.7	1.39	64900	64000	900	2210	242
17	13	7½	99.0	87.0	77.2	1.67	84000	82600	1400	2210	241
17¼	13¾	12½	96.5	93.6	83.0	1.765	90600	88900	1600	2156	314
21½	10	14¾	96.1	68.2	60.3	.461	65100	64800	300	2150	211
16¾	12¾	7½	95.5	84.2	74.6	1.11	81000	80100	900	2136	226
15⅝	10½	11¾	95.4	79.3	70.2	2.33	77200	75400	1800	2133	178
19	14	9	95.2	80.6	71.4	2.42	78500	76600	1900	2120	227
13¾	8¾	10¼	94.7	78.0	68.8	.404	74300	74000	300	2 18	316
15⅝	10⅝	11¾	94.2	78.1	69.2	2.62	76200	74200	2000	2108	215
15⅝	10⅝	11¾	94.1	52.2	46.2	1.98	50600	49600	1000	2108	236
14¼	14¼	10½	93.9	62.8	55.5	1.49	60400	59500	900	2094	305
13⅞	10¾	7½	93.3	82.5	73.0	.76	79000	78400	600	2086	205
14	10⅝	8½	93.2	93.2	82.6	Zero	88600	88600	Zero	2080	162
14	10⅝	5⅝	93.2	90.0	79.7	.117	85600	85500	100	2080	163
14	10⅝	9⅝	93.2	84.4	74.8	.248	80500	80300	200	2080	164
14	10⅝	6¼	93.2	82.1	72.7	.510	78400	78000	400	2080	159
14	10⅝	9¼	93.2	81.0	71.7	.517	77400	77000	400	2080	158
14	10⅝	6½	93.2	81.0	71.6	Zero	76800	76800	Zero	2080	165
14	10⅝	9½	93.2	79.4	70.7	.654	76400	75900	500	2080	160
14	10⅝	7¼	93.2	79.2	70.2	.397	75600	75300	300	2080	161
14	10⅝	12	93.2	78.9	69.9	.133	75100	75000	100	2080	167
14	10⅝	11¾	93.2	77.3	68.4	.406	73800	73500	300	2080	166
16	13	11½	93.2	75.6	66.8	4.65	75300	71800	3500	2080	313
14	10⅝	7¾	93.2	68.0	60.3	.615	65000	64600	400	2080	168
14	10⅝	15	93.2	66.0	58.4	.319	62900	62700	200	2080	169
16½	12½	5¼	92.2	91.2	80.8	.37	87100	86700	500	2060	173

Fig. 87 - Tabulated "Efficiency Index" for patterns used in Pallet Pattern Manual NAVSANDA No. 269. Neg. No. 348-13.

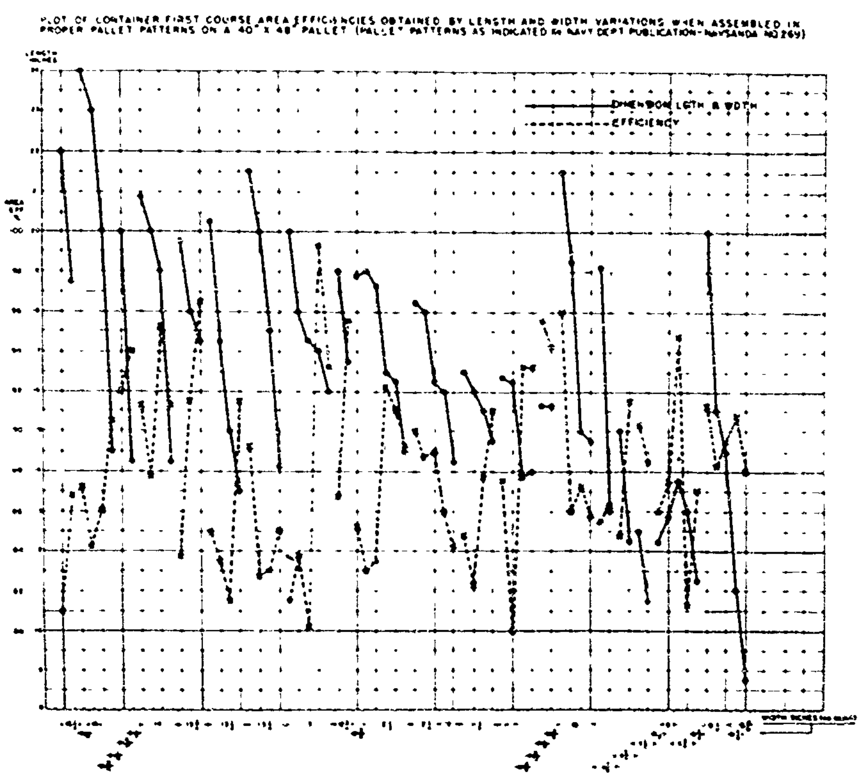


Fig. 88 - Graphical correlation for data in NAVSANDA No. 269. Neg. No. 348-12.

of the deficiencies of this kind of presentation is that it is only pictorial. It doesn't say anything about the different sizes which will fit within those patterns, and doesn't say anything about the efficiency available.

You can get many of these pictorial charts commercially. Very often certain industries, which have characteristic container sizes, will put up this kind of a pictorial demonstration for their own use.

Figure no. 86 is a typical type of coordinate chart which is available commercially. I think one of the trade magazines had this kind of a chart. This is a pallet selection system in which all you have to do is take the width and length and find a pattern that is indicated in that little box at the intersection of the dimensions. However, no efficiency is mentioned, so you have no way of selection as between alternate boxes, and then, for instance, there may be six different patterns. You have no way of differentiating between those six patterns on the basis of comparative efficiency.

Figure no. 87 shows the initial tabulation of the data that we had originally abstracted from this handbook. It was set up in the order of efficiency; which is the fourth column. There was no trend visible. Actually, we were trying to get some kind of correlation. However, due to the limited number of sizes that are in this handbook, we couldn't get any correlation. We also tried graphical correlations as shown in Figure no. 88 and didn't get any results. As you can see, it only served to illustrate the difficulty of obtaining any trend, mainly because there were too many variables and too much data. It was so complex that we couldn't really pick out any trend.

Figure no. 89 is the basis of the selection charts which we have designed, and we have two of them on the wall. I can discuss the charts in detail with anyone later who would be interested. The main point about the sample chart is that it illustrates, by a graphical method, how we can get a more efficient pallet pattern, or a more efficient container size.

It is this triangle, giving the container width and length, which permits us to use the selection process. We can take a definite container width and length, and come out at a particular point on the graph. As an example, at the points marked "X" we have definite sized containers which are only slightly over 80 percent. However, on this pattern, up in the corner of the triangle, we have 100 per cent

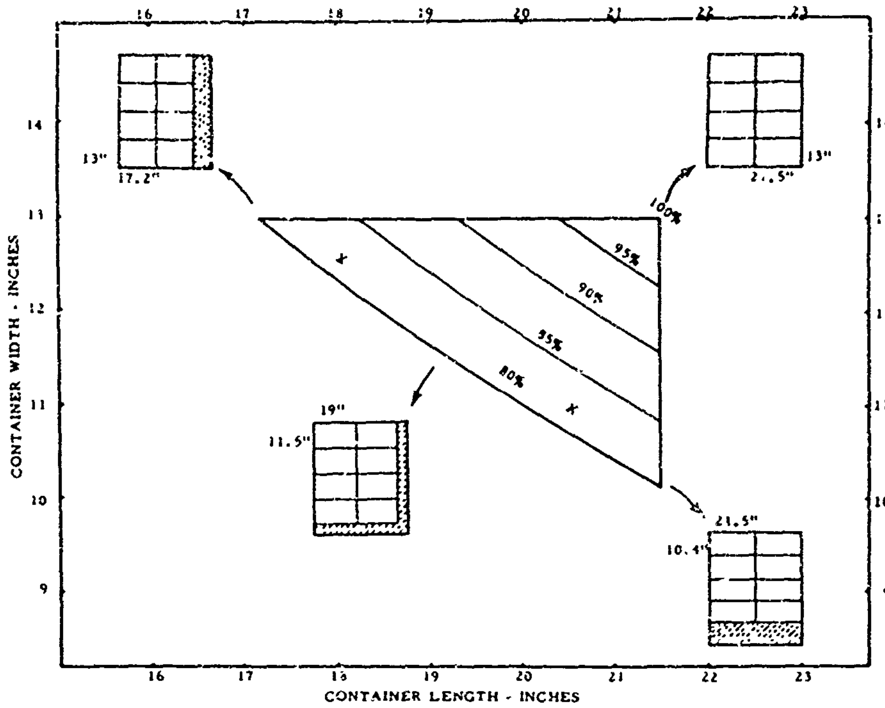


Fig. 89 - A sample graphical solution for one pattern. Neg. No. 308-12.

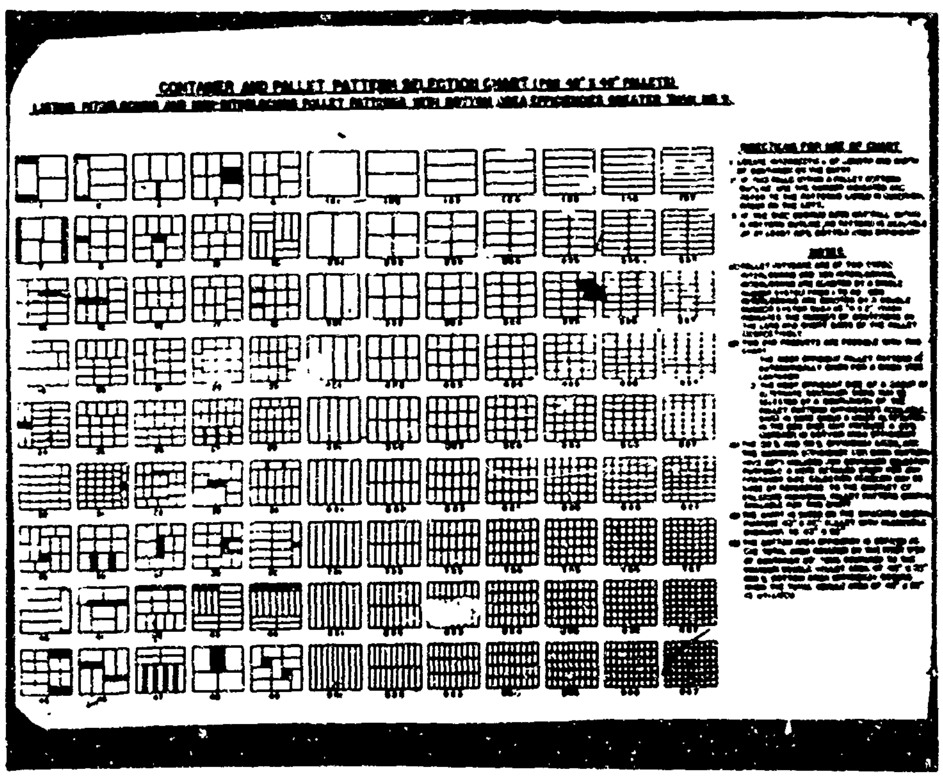


Fig. 90 - The 108 patterns used for the final selection charts. Neg. No. 348-15.

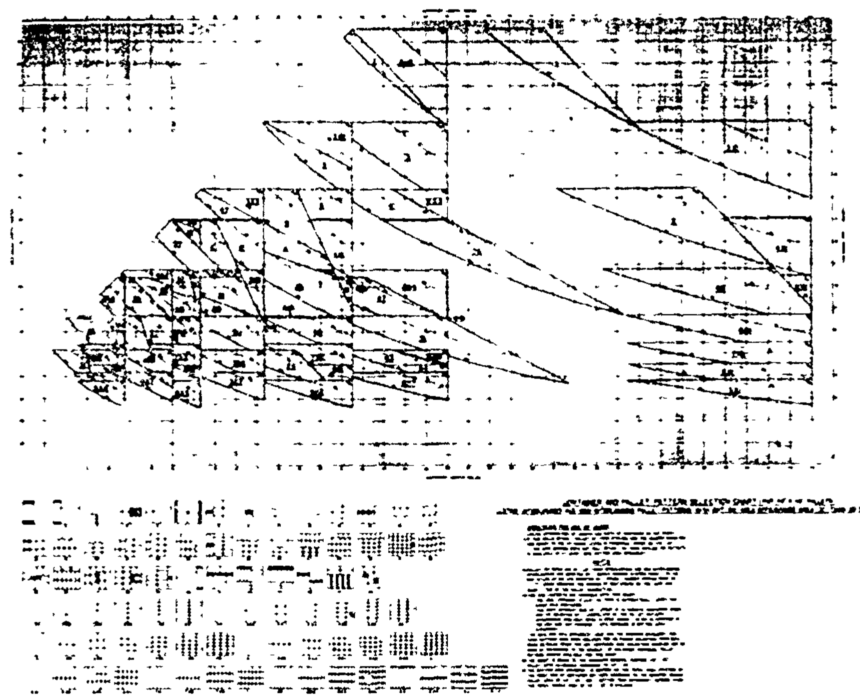


Fig. 91 - Simplified selection chart Drawing No. SED-SK-506. Neg. No. 348-7.

1. Select the best pallet pattern to be used for a given size container.

2. Select the most efficient container size out of a group when alternates are available.

Fig. 92 - The two advantages to be gained from the use of the graphical selection method. Neg. No. 348-4.

efficiency. The important utility of this chart is that it permits us to move away from the 80 percent efficiency lines and get as close to the 100 per cent point as possible by changing the container dimensions slightly.

If, in working with this particular pattern area, we can make our selection point and get a definite size -- 13" by 21-1/2" we will have 100 percent efficiency. That pallet pattern we are talking about is completely filled up with no spaces or voids left over. The dimensions of the 100 percent point were varied algebraically to give the 80 percent points, which were 17.2" by 12" on the one corner and 21.5" by 10.4" on the other corner of the triangle. Sufficient points were compared to plot the boundaries and the efficiency lines of the pattern selection area. If alternative sizes are available the answer is obvious. We would select the more efficient size which in this case is 20 percent more efficiency right on this particular pallet pattern.

One major advantage of this kind of calculation and presentation was that it allowed us to get increments in very small sizes instead of the half inch or so ordinarily available in commercial charts. Now we had a graphical solution which worked out well, and a large number of pallet patterns to evaluate by this method.

Figure no. 90 shows the 108 pallet patterns we used for the large selection charts. These 108 were left after elimination of inefficient patterns and duplicates, and overlaps of all pallet patterns we were able to find, which eventually totaled over 400 patterns. These are the most efficient ones we could find, and covered the ranges of sizes in which we were interested.

The method of presentation is important because we separated interlocking patterns, which are important in certain instances, from non-interlocking patterns. A choice of pattern type was available, and the selection depended on the requirements. An especial advantage of this particular presentation is the power of the method, and this is illustrated by the fact that we cover a range of about 20,000 different box sizes in increments of an eighth of an inch, and therefore have a very wide range of selection.

The original chart, which was illustrated in the first slide was designed to cover all the possible sizes from a minimum of a 5-inch dimension to a high of a 52-inch dimension. That is a very wide range. In the interest of legibility, a simplified chart was drawn as illustrated in Figure

number 91, and you will note that is a lot clearer. Very small, or very large container sizes were omitted, resulting in the simplified chart which we like to call a Navy Pallet Map, and we have a sample on the wall. It is almost exactly the same as the original large chart except that we have colored in the selection areas. It is much easier to read, and I'd like you to take a look at it later.

We are testing out these charts now, right at Bayonne Naval Dep. . Supervisory personnel became interested and requested 30 copies for the use of their warehousing people. It must be realized that it is difficult for the ordinary warehouseman to use complicated handbooks and charts, or any method requiring a computation or difficult selection. We must make his method of selection of a pallet pattern as simple as possible, so that he will use it.

In Figure no. 92, I want to outline the advantages again, because that is important. With the use of these charts, we can select the best pallet pattern to be used for a given size container, and, as far as we are concerned, this is our answer until we find something better. Second, we can select the most efficient container size out of a group when alternates are available. Alternates are often available at the main production areas. When the manufacturer wishes to package any kind of an item whose outer container sizes can vary, like small boxes, and nuts and bolts, and sometimes clothing and loose odds and ends, or little pieces of material, we can often change the container sizes without too much difficulty.

Now, we feel these selection charts should help in the general packaging situation by eliminating odd sizes, and will also increase cube efficiency by eliminating inefficient patterns, so that we will have a steady trend toward more efficient cube utilization.

All the slides we had shown before described our work on improved cube utilization with cartons and boxes as palletized unit loads and these, of course, occur mainly as rectangular shapes. There is one other large class of material in which we are interested, however, and these are the cylindrical objects such as cans, drums, cylinders, bottles, jars, pails, and so forth.

Figure no. 93 illustrates the general characteristics of nesting patterns of cylindrical objects. You will notice that, instead of being in lines and rows, we have nested these circles together so as to show you the different loss

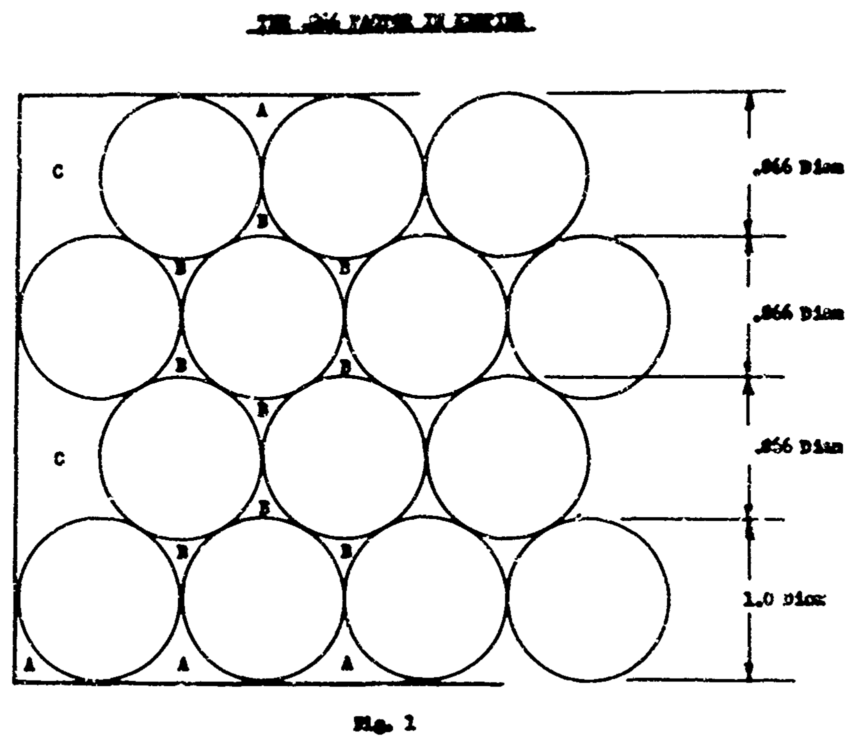


Fig. 93 - The .866 factor which accounts for the improved efficiency in nesting. Neg. No. 348-2.

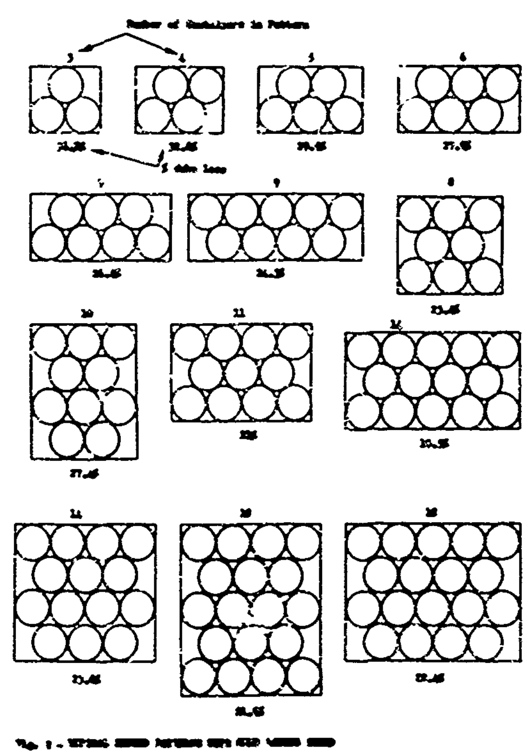


Fig. 94 - Typical nested patterns for small numbers of containers. Neg. No. 348-5.

EFFICIENCIES
POSSIBLE PATTERNS UP TO 18 CONTAINERS

NUMBER OF CANS	PACK STYLE NESTED	PACK STYLE NON NESTED	NON NESTING LOSSES	NESTING LOSSES
1		X	21.5%	
2		X	21.5%	
3		X	21.5%	
	X			43.6%
4	X			33.4%
		X	21.5%	
5	X			32.4%
6	X			27.5%
		X	21.5%	
7	X			26.6%
8	X			23.8%
		X	21.5%	
9	X			24.4%
		X	21.5%	
10	X			28.8%
		X	21.5%	
11	X			22 %
12		X	21.5%	
13	X			24.2%
14	X			20.7%
	X			24.8%
		X	21.5%	
15		X	21.5%	
16		X	21.5%	
17	X			19.8%
18		X	21.5%	
	X			22.2%
	X			20.5%

Fig. 95 - Tabulated efficiencies for nested patterns of small numbers of containers. Neg. No. 348-8.

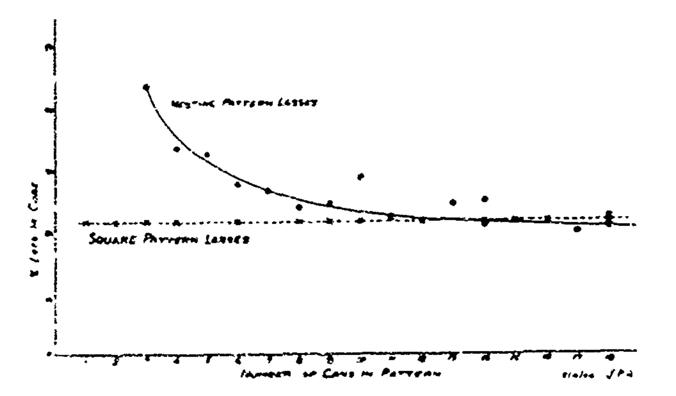


Fig. 96 - Plot of efficiencies of nested patterns of small numbers of containers. Neg. No. 348-10.

areas. The fact that nesting of cylindrical objects results in improved efficiency is generally known, however, the exact details are not a matter of common knowledge, and have never been comprehensively explored.

As a result of the work we have been doing, it has now become apparent that real economies are possible under certain conditions. The big fact, of course, is that .866 ratio. Once we get the first row in, nesting every additional row takes up only .866 of the diameter of any circle so, if we go far enough we are saving a lot of space. Different loss areas are shown, the C areas are high loss areas, the A's are the edges, and the interior areas B are very small losses compared to that obtained in a random case of, say, canned goods. These are the important factors with which we are working. Actually, of course, the size of the pattern makes all the difference. With increasing size of pattern (number of containers) the edge losses minimize because of the saving in the interior areas, and we get an efficient pattern.

Figure no. 94 illustrates the method of nesting various small sizes of patterns. It is apparent that the cube losses are high with only a small number of cans. The loss varies from 46 percent for three cans down to a loss of 21.9 percent for eighteen cans. These figures have been tabulated in order of number of cans, and figure number 95 shows the nesting losses decreasing with increasing number of cans. There is little to be gained in nesting small numbers of containers, such as canned foods, which are usually packed in 12 can layers in fiberboard cartons.

These data are also plotted in figure number 96 and illustrate graphically the trend to decreasing cube losses with increasing number of cans. The solid line is the square pattern loss which is constant. However, the dotted line shows the increasing efficiency of the larger numbered nested patterns.

There are other factors, of course, which are important, such as amount of — carton materials used, height; strength of the load, etc. However, this information does show that nesting will give us better cube efficiency as we get to larger numbers of containers.

Figure number 97 illustrates the marked effect on cube efficiency by nesting of large numbered patterns. It is in this field of large numbered patterns of cylindrical objects that the best results can be obtained by nesting. A typical situation is illustrated in the first pattern of this slide.

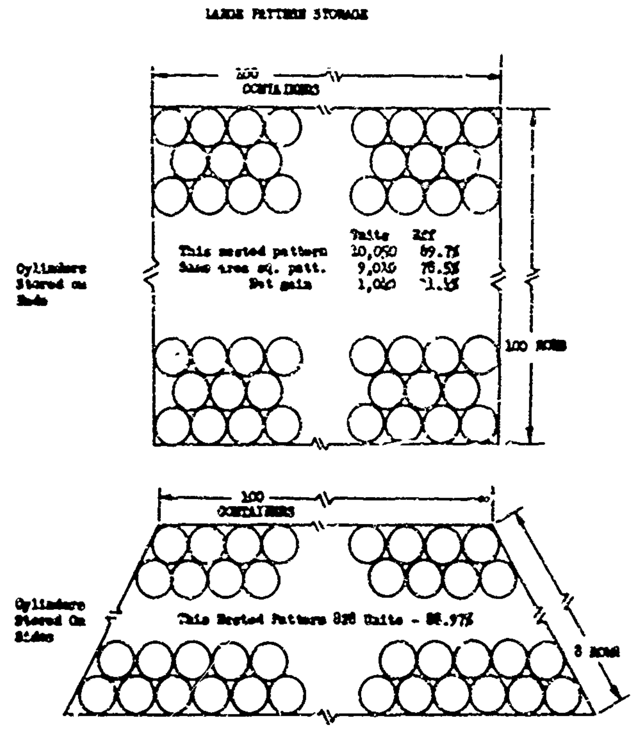
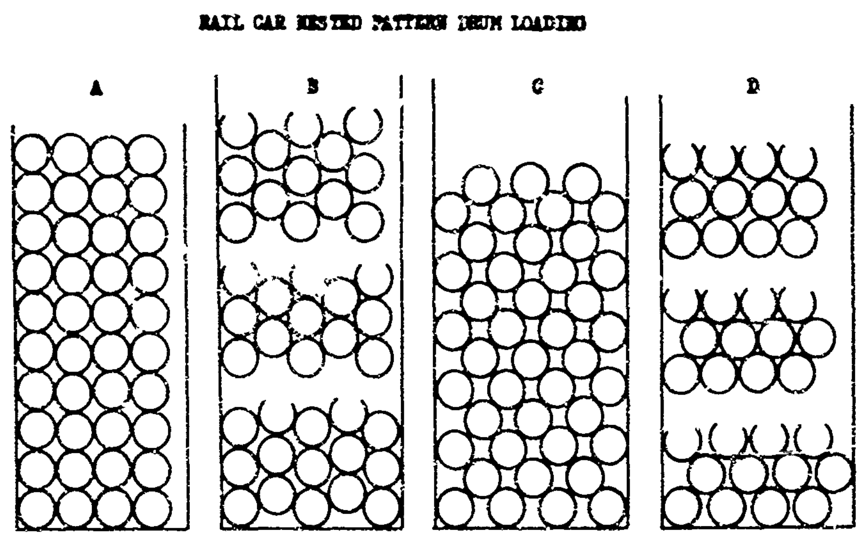


Fig. 6

Fig. 97 - Examples of nested patterns for large numbers of containers. Neg. No. 348-6.



Number of Drums in Half Carloads of Various Widths and Patterns

Car Width		101"	102"	103"	104"	105"	106"	107"	108"	109"	110"	111"	112"
Pattern	A	40	40	40	40	40	40	40	40	40	40	40	40
	B	43	45	45	48	48	48	48	48	48	48	48	48
	C	42	42	42	42	42	42	42	42	42	42	42	42
	D	40	40	44	44	44	44	44	44	44	48	48	48

Fig. 7

Fig. 98 - Examples of nested patterns loading in rail cars. Neg. No. 348-3.

TABULATED EFFICIENCIES FOR PALLETIZED CIRCULAR CONTAINERS*

CAN DIAM.	SQ. PATT. EFF.	NEST PATT. EFF.	GAIN IN EFF.	# IN OLD PATT.	# IN NEW PATT.	NET GAIN	# ROWS IN OLD PATT.	# ROWS IN NEW PATT.
1/2"	78.5	90	11.5	8944	10,247	1103	86	99
1"	78.5	89	10.5	2236	2,524	288	43	49
2"	77	86.2	9.2	546	612	66	21	24
3"	75.4	83.5	8.1	238	264	26	14	16
4"	73	84.3	11	130	150	20	10	12
5"	70.4	79.2	8.8	80	90	10	8	9
6"	71	81	10	56	64	8	7	8
7"	72.5	67	-5.5	42	39	-3	6	6
8"	67.5	80.8	13.3	30	36	6	5	6
9"	57	71.1	14.1	20	25	5	4	5
10"	70.3	70.3		20	20		4	4
11"	56.6	67.8	11.2	12	16	4	3	4
12"	60.8	56.8	-4	12	11	-1	3	3

* Based on the Standard Navy General Purpose Pallet of 40" x 48", with allowable overhang to 43" x 52"

Fig. 99 - Tabulated efficiencies for cylindrical containers in nested patterns of the 40" x 48" pallet. Neg. No. 348-9.

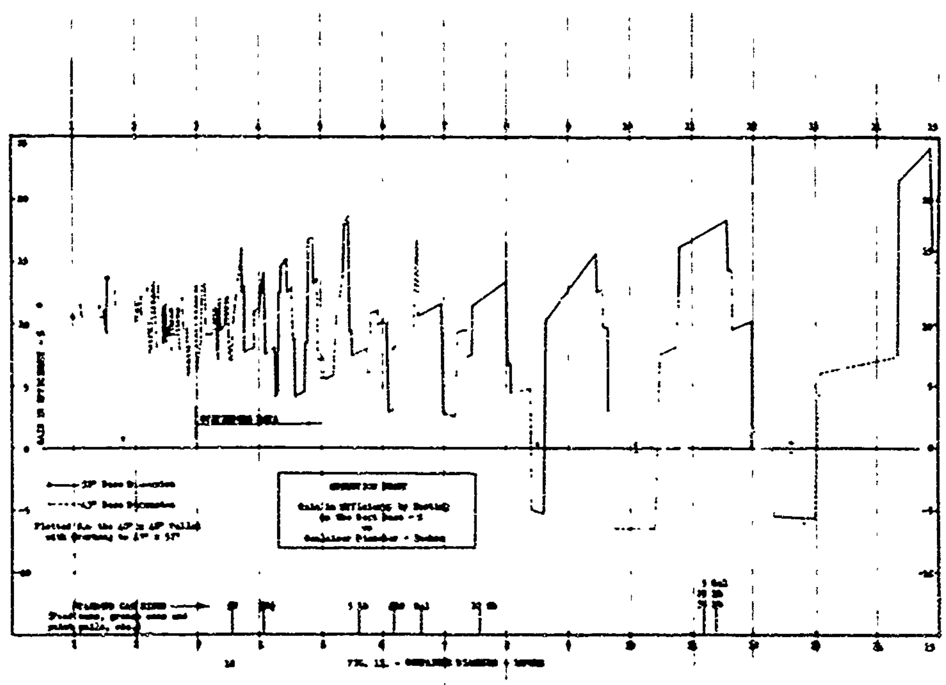


Fig. 100 - Selection chart for nesting of cylindrical containers in solid unit loads on the 40" x 48" pallet. Neg. No. 348-1.

An area which would hold 9,000 cylindrical containers in a rectangular pattern will hold an additional 1,000 containers in a nested pattern for a new total of 10,000 containers. This may seem obvious, however, only recently I saw a picture of a pier in New York loaded with oil drums in nice neat rows. I suppose someone would be delighted to see that neat orderly pattern, however, he would be missing out on storage space for several thousand additional drums.

Figure number 98 illustrates the effect of nesting as related to the widths of rail cars. Included is a tabulation to show that nesting, which is usually done in rail cars, will give a better cube efficiency. In the case of drums, actually, the rolling hoops complicate the situation. However, the tabulation gives a general idea of the number of cans or drums which will fit in a restricted rectangular space and illustrates the importance of nesting. There are enough variables so that each particular item in each particular car is a definite problem for evaluation.

Figure number 99 is a tabulation of an initial attempt we made to set this kind of nesting criteria up for pallets. It is also based on the 40" by 48" pallet with allowable overhang to 43" by 52" which we consider a standard. We did find out right away in working with this idea that we could get more containers by nesting because this is a solid load and not separate containers, not few little cans in one package, but a whole solid load of anything, shells, cans, drums, pails or any cylindrical container.

Figure number 100 is the final result on this cylindrical container project and is important because it gives us another selection chart. If you're talking about solid loads of cylindrical containers to go on the 40" by 48" pallet, this is the way to do it.

You can follow the chart across the horizontal axis to find any particular diameter. The #2, #2-1/2, 5 lbs., 10 lbs., one gallon, 5 gallons, and other sizes are marked. Of importance to us is the fact that almost everywhere along this zero line, the breakeven line, we get better efficiency by nesting than by not nesting. For example, at about 11-1/2 inches on the chart, we can et about 18 percent more containers on a pallet by nesting than if we loaded the pallet in a square pattern.

That's it, gentlemen.

CDR FULLAM: Are there any questions, gentlemen?

(Applause)

MR. L. S. CASTILLO (Naval Ordnance Exp Unit, NBS, Wash.): Have you given any consideration to making the slide rule for the efficient selection of a pallet size?

MR. AKREP: Efficient selection of pallet size itself?

MR. CASTILLO: Right. Such as on your chart.

MR. AKREP: The chart, of course, is for a definite pallet size container.

MR. CASTILLO: Have you ever worked up a slide rule to utilize those pallet sizes?

MR. AKREP: No, we haven't worked on other pallet sizes.

MR. HEINRICH: I would like to comment on that, if I may. At the present time there is an effort to standardize on pallet sizes as far as possible. The American Standards Association in conjunction with the American Society of Mechanical Engineers, and also with one of the Materials Handling Societies, and the Navy Department has spent considerable time and investigation of the size of the 40" by 48". We, in the Armed Services, have standardized on that to a great extent. We do use other sizes, but not to the extent that we use that one size. We are not interested in the Armed Services in seeing a great multitude of sizes. We want to cut those sizes down as private industry is doing.

Now, there are a number of very good reasons why certain industries are going to larger or smaller sizes, which is due to the weight or subject of the commodity that they are manufacturing. However, if we go into a standardization program, we can develop charts like this which will automatically standardize on the container sizes which will best fit on our standard pallets. For that reason we're not interested in those other sizes at the present time. Has that answered the questions?

MR. I. FOOTLICK (Kamen Associates): Some of the pallet patterns you show have gaps in them. We in industry have been fooling with clamp trucks. The gap is one of our hindering factors. Have you done any work with that in your pallet arrangements to come up with, for example, how much more might have to be given to those boxes to get an increase of an eighth or a quarter to make it possible to use the clamps on them?

The other factor that is interesting, and it is part of a talk I'm going to talk on this afternoon, is we have development of a new car which shows unit loads fit into it. Then it's going to be necessary for you to eliminate any gaps in one direction in order to take up the shifting of the car. Have you people done any work in that general direction? Have you attempted to limit your gaps in one direction? If you have, then it makes it easier to use clamps on the trucks.

MR. AKREP: We try to avoid the gaps in these patterns as much as possible, as, of course, we would have more cube efficiency that way. The only thing you could do in this case would be to select your patterns in group. There is a lot of overlapping in the pallet patterns and our charts show only the most efficient ones.

One of the things you could do is go to the next lower efficiency if that pallet pattern fits your requirements of no gaps. For example, if you have to go to the next lower one, it might save you trouble in your handling problem. That may very well work out for what you are talking about. We have not given that any consideration and do not know for sure.

CDR FULLAM: Are there any further questions, gentlemen? If not, on behalf of my superiors and myself, I would like to express my deep appreciation and thanks to Colonel Maidt, Lieutenant Colonel Cullinan, Mr. Snell, Mr. Ryan, Mr. Heinrich and Mr. Akrep for their presentations this morning, and also to express my thanks to you for having attended.

I believe now we can adjourn.

(Adjourned at 1215.)

Morning Panel Session

Wednesday, October 12, 1955

A5. Automation of Packaging Lines for Military Items
Chairman, Mr. William Bronander
Scandia Manufacturing Company

Automation of packaging lines for military items and problems yet to be solved.

Mr. Roger Putnam
Package Machinery Company

Mr. Howard Stewart
Standard-Knapp Division
Emhart Manufacturing Company

Mr. William Boston
Bartelt Engineering Company

Mr. Frank Quinby
Grace Chemical Research and Development Company

Mr. Benjamin Karpowicz, Jr.
Pak-Rapid, Inc.

Mr. Frank Rubinate
Food and Container Institute
Quartermaster Corps, Chicago

Mr. E. H. Cawley
Signal Corps Research and Development Laboratory
Philadelphia

Mr. John Attaway
Mid-States Gummed Paper Company

Mr. Robert Farrell
Marathon Company

Automation of Packaging Lines for Military Items

A General Discussion Panel

MR. W. B. BRONANDER (Scandia Manufacturing Company): Gentlemen, welcome to the first technical session on packaging machinery automation.

Yesterday, we had a talk by Mr. Roger Putnam of the Package Machinery Company, and he invited questions at this morning's session. I suggest we start off by asking Mr. Putnam to elaborate on his suggestion for setting up a committee to work with the military on the problems of automatic packaging.

MR. PUTNAM (Package Machinery Company): I was very serious about the suggestion I made yesterday. I think it would be very valuable if we could get together in a real joint effort and on a more or less official level. Through such a committee, I believe we could find ways and means of helping one another with the problems arising with packaging for the military.

I think the civilian industries should appoint good committees that will carry weight with the members of their respective industries. Also, I believe the military should appoint a committee with authority to reach agreements, or at least one whose recommendations will carry a great deal of weight within the military establishment.

Summarizing, I feel sure that the only way to solve the problems facing everyone in military packaging is to set up a joint Military-Industry Committee that will have real stature when it comes to solving problems dealing with packaging automation.

Now, I am ready for questions!

MR. IRVINE: There seems to be a differential in the definition of packaging. When you talk about automatic packaging of parts, do you mean crating machinery or machinery for packaging small products?

MR. PUTNAM: K-rations are an example of the things that lend themselves to automatic packaging. First, you must have volume, and second, the product must be fairly uniform in size which is the case in most civilian packaging.

MR. IRVINE: I wondered whether the discussion could be guided along the packaging of small items before moving to larger packaging?

MR. BRONANDER: We are planning to do that Mr. Irvine. We have invited a number of people here today to discuss actual case histories using automatic packaging machinery. Questions will follow each talk.

Returning to Mr. Putnam's suggestion for a joint committee, do you have any questions as to the make-up of the committee or its responsibilities?

MR. STEWART: Mr. Putnam, is my understanding correct that your suggestion of a committee would follow in something like that Integration Committee of the Operators of Arsenals, like the American Safety Razor Company, or Remington Arms, or Procter & Gamble, who operate United States arsenals for the Government, and then their representatives meet with the OAC, and other Government agencies, in a committee to find out what the Government wants from industry and so on?

MR. PUTNAM: Unfortunately, I am not familar with this committee that Mr. Stewart described and cannot say whether or not it is similar to my committee suggestion.

My idea was that we are working largely in the dark, insofar as military packaging goes. It may be that existing specifications could be changed in some way to incorporate the use of automatic packaging machinery. I feel sure that the members of the committee representing the military, the supply industries, and the machinery manufacturers could work together to bring about savings in money and manpower in peace-time and to prepare programs for over-night expansion in case of national emergency.

MR. MULLANEY: I think any type of automatic machinery must, by necessity, use some sort of flexible barrier material. In the packaging of spare parts on automatic machinery, it is often necessary to package certain items to a higher degree than the contract and the general specifications deem necessary. When this happens, we have to get special permission to exceed the specification. This is quite a problem and I suggest a general specification be set up, such as JAN-P-100 or MIL-P-116, with some sort of stipulation wherein you could exceed the specification if you thought it necessary in order to utilize automatic equipment.

MR. PUTNAM: This would be a good project for the committee.

MR. OLSON: Mr. Putnam, I would like to suggest a timely topic for inclusion on the agenda for the committee; namely, that packaging equipment be built with more flexibility or versatility, to meet the changing demands in packaging, both for domestic consumption as well as military consumption.

MR. PUTNAM: Now versatility is a very important thing in a machine, but speed and sometimes great accuracy is needed, these thing not always with versatility. However, there is no question but our machines should be more versatile. We need such a committee as I am talking about to bring out this type of constructive criticism. We are much more flexible than we were ten years ago, and I suspect the next ten years will bring out new machine designs that will overcome all of the problems confronting our industry today.

MR. BRONANDER: When I received this assignment, I made a number of inquiries and found only a few isolated cases where automatic packaging machinery had been used or is presently being used for military packaging. The use of semi-automatic equipment and small specially-designed portable units seems to be in wide use at present.

The session this morning will cover a number of actual case histories that are not only interesting but show how packaging machines have been put to use on military work.

We will start with Mr. Howard Stewart, of the Standard-Knapp Division of Emhart Manufacturing Company, describing the use of automatic conveying equipment in connection with automatic shell-loading machines.

MR. STEWART: Our company worked on a project at the Lake City Arsenal in Independence, Missouri. Equipment was built to automatically handle and convey, load and unload, 20 mm. cartridge cases.

The cases are made from brass and picked up at the final trimming operation. Each case is positioned in a separate pocket on a power-driven conveyor. The cartridge cases move along to a loading machine which automatically places 100 cases into tote boxes having compartments arranged ten by ten. These tote boxes move to another part of the building where they are unloaded and carried, via pocket conveyors, into gauging machines using air actuated controls, electronics units, etc., working automatically to feed the machines.

These conveyors and special machines are set up to handle 360 cases per minute. Before our system was placed in operation, between 55 and 60 people were used on the line. Now, 27 people are used with production increasing from approximately 85,000 cases in eight hours to a potential of over 125,000 cases.

MR. BRONANDER: Could this automatic conveyor system be adapted to other operations?

MR. STEWART: Yes, it has been adapted to a number of other shell lines as well as many private industries for non-military products.

MR. BRONANDER: Our next speaker is Mr. William Boston of the Bartelt Engineering Company with a description of their work on packaging of percussion caps.

MR. BOSTON: We supplied a machine to the Revena Arsenal for packaging primer percussion caps in special foil-lamination bags or pouches. However, a number of problems confronted us. An explosion-proof machine was required which called for special electrical engineering. All of the control equipment was located outside the critical area. Otherwise, the machine was similar to that supplied private industry for every-day products.

Our company also manufactures vacuum packaging machinery for food products. The empty packages made on our machine enter a chamber from which we evacuate all of the air. Each bag is filled and sealed while in the chamber. As Government specifications call for no more than two percent oxygen to be present in each package in order to prevent rancidity, fungus growth, etc., the machine must be carefully engineered to meet the requirements of each product.

MR. BRONANDER: Mr. Frank Quinby of the Grace Chemical Research & Development Company, will review his company's work on the transparent packaging of small parts.

MR. QUINBY: We have been working on transparent packaging of items, such as bearings, over the past two years. Here is a cellulose acetate transparent package with ten bearings individually sealed inside. (Demonstrating) Plans are under way for making this type of package automatically. Specification MIL-B-197B, under which instrument bearings are bought, is in the process of being amended to include this type of transparent packaging.

We visualize an automatic machine with a strip of plastic material, perfectly flat, feeding from a roll, in the required width, moving into a heated tunnel where it is heated until it is soft and pliable. The strip then enters a station where the material is pressed into pockets by simple punches. The strip continues on through the machine and clean bearings are automatically dropped into the pockets along with a measured scope of oil to fill the individual pockets. Another strip of plastic feeds down from above and is sealed to the first strip with the depressed pockets now holding the bearings and lubricant. This second sheet of plastic can be printed and positioned electronically before being sealed. A guillotine-type cutter completes the operation cutting the sealed bearings off in sheets of ten or twelve or other quantity as required.

Several thousand of the same size bearings would have to be packaged at a time to make such a machine investment worthwhile. Besides being transparent, making it possible to instantly identify the bearings, the problem of inventory is greatly reduced. At present, an inventory of 16 to 18 different size tin cans is required whereas the transparent plastic can be purchased in standard width rolls.

Sears & Roebuck stores offer a large number of hardware items in somewhat similar packages, known as "blister" packaging. Here, a transparent plastic form or "blister" is heat-sealed to a board on which is mounted the hardware item and includes screws or any other parts accompanying the hardware item. There is a place in military packaging for this type of plastic package also.

Another form of plastic packaging is known as "skin packaging" where the pre-heated plastic material is drawn down over the item to be packaged and sealed directly against the board of plastic bottom sheet. This type of packaging is highly specialized and requires additional development.

MR. BARSOOK: Have any tests been made relative to long-term storage, the possibility of deterioration of the material used, and so forth?

MR. QUINBY: Yes, tests are underway at Hyatt in Harrison, New Jersey. A report received a month ago on bearings and rollers from bearings showed no signs of deterioration after a year of shelf storage tests.

LT. GOBEL: The Navy has several projects underway on bearing packaging, and has established contracts with commercial concerns to repackage and represerve bearings. It has been a problem, not only in our depots, but aboard ship.

The questions in my mind are: (1) will this type of packaging prevent the represerving of parts such as bearings, and (2) would it be possible to run these unit packages out in strips of twelve and cut them off individually later on without destroying the preservation of the other items in the strip?

MR. QUINBY: Yes. One of the main ideas back of this method of packaging is to overcome the difficulties that you are now experiencing when you package ten bearings to a vial and have to dump the whole vial in order to get one item.

The answer to your second question is also yes. New techniques in sealing the plastic calls for the use of perforating needles so that the resulting strip is similar to a sheet of postage stamps and permits one part at a time to be removed.

One of the paper board manufacturers is now prepared to sell a container consisting of two plastic pieces, the top and formed bottom, at prices ranging from $165.00 a thousand in large quantities to a little over $200.00 a thousand in relatively small lots. The machine required for heat-sealing these two pieces costs about $2,000.00. Loading and sealing these units would add approximately $200.00 a thousand to the cost of the container.

CDR BOWMAN: Does this material react favorably chemically with the various types of preservatives and metals to be packaged and is there any softening or swelling over a long period of time?

MR. QUINBY: This sample is made of cellulose acetate. So far, no oil has been found that will go through or soften it -- based on tests running for a period of a year. Other materials being tested include cellulose acetate butyrate and rigid vinyl.

MR. GIGOX: Does "blister" packaging require expensive complicated machinery?

MR. QUINBY: No. This is being done commercially by vacuum formers on fairly small runs. The prices currently being quoted on blisters run as low as a penny a piece in

lots of 50 to 100,000. I have seen "blister" packages of hardware items in Sears & Roebuck priced for as low as eleven cents each.

MR. BRONANDER: What is the largest item packaged in this manner?

MR. QUINBY: A Hyatt aircraft bearing, weighing about 10 pounds, is the biggest item that has been packaged individually. The Bureau of Ships has a research development program underway for their ships stores. The automotive industry is also looking into this type of packaging for their spare parts.

We picked bearings because we figured they represented the toughest packaging problem that exists.

MR. BRONANDER: Mr. Benjamin Karpowicz, Jr., of Pak-Rapid, Inc., will be our next speaker.

MR. KARPOWICZ: Our company has produced several different machines for packaging spare parts in flexible materials.

Several machines have been supplied to the Military that are capable of packaging odd sizes and shapes without making adjustments or changes.

We have a printing unit, mounted on these machines, that will print the proper nomenclature and identify the product being packaged. If anything goes wrong, the machine stops automatically. These machines have been designed to handle heavy gauge barrier materials and are equipped with counting controls for predetermined production runs.

For example, the packaging of 10,000 different items might be handled on four machines, each set-up for a specific package size. These items would be keyed to each machine depending upon their relative size and shape. The parts to be packaged are fed into the machine from trays which are placed in position on the machine. Change-over time is 10 to 15 minutes so that grouping the parts together is important to save time.

Some parts are a little small for the size bag that is used but this is off-set by using standard-size bags on items packaged in small quantities. Bags made on standard models measure six by six inches and ten by ten inches on larger model machines.

MR. MULLANEY: Are your machines fed vertically by gravity?

MR. KARPOWICZ: Yes. We can feed fragile items such as radio tubes, small coils, and similar items.

MR. KADDICK: About two years ago, we in Federal Telephone tried to adapt an automatic machine for packaging spare parts. We found that such a machine is not economical unless a specified quantity is to be packaged at one time.

MR. KARPOWICZ: It depends upon how many parts can be grouped together for a production run. Even if the machine runs only one or two days a week, it can prove to be economical.

MR. KADDICK: Will you describe your printing operation?

MR. KARPOWICZ: We have two methods; cast rubber-faced type, and printing with a ribbon which requires a separate mat or plate for each part. The use of a typewritten stencil is also being considered.

MR. KADDICK: With ten or twenty contracts, the printing becomes a serious problem and makes the use of an automatic machine quite impractical.

MR. BRONANDER: Mr. Frank Rubinate, of the Quartermaster Corps, will describe the work that is going on in their Chicago Laboratory.

MR. RUBINATE: I think it is evident here this morning that there is considerable interest on the part of the military in packaging "automation."

We have been very much aware of the need for going to automatic operations wherever necessary, particularly in the packaging of food. We are buying items in large quantities, and must have some means of getting them packaged for us in a hurry and in large volume. As a result, most of the items in our operational rations lend themselves to automatic packaging -- soluble coffee, soluble tea, various dehydrated soups, and items of that nature.

We run into problems like the following: Take an item that is normally packaged in a can but we want to put it into a flexible packet. We find that, while the equipment to do that job is available, it is not available in the industry that produces that item. For instance, a big packer is set

up for a certain item, but all in cans. Should we desire to cut that item down to a one-ounce quantity and put it into a flexible packet, we would not be able to get the packer to do that; it would have to be done on some kind of a subcontract basis with a contract packager - all of which leads to an increased cost.

Candies are a very important item in our operational type of rations, such as C rations and the five-in-one rations. In times of emergency, we buy literally millions of bars of candies of various types. We have persuaded the industry to standardize on sizes for the various bars. However, because of limitations in the wrapping equipment available in the various plants, we are limited in the types of materials that can be used to wrap the candy. We cannot use aluminum foil or foil combinations in many instances because the existing equipment is not set to operate efficiently with that material. Generally, it operates best with cellophane or glassine. Sometimes, the equipment may be able to handle foils but the type of seal that is produced, while satisfactory for commercial use, is so poor from our standpoint of long-term storage that we would, in effect, be wasting a critical material. Under conditions like this, we accept the commercial item, the commercial wrap, but we then take steps to over-pack the candies to give them the additional protection necessary.

In the five-in-one rations, we will take five candy bars of a type and place them in a flexible bag. At present, this is a hand operation. The C ration candy bar is included in the accessory packet which is a foil-kraft combination.

We know from experience that we cannot use cellophane or glassine for our operational rations which are stored up to two years in different parts of the world. Even when they are placed inside another packet with other items present, there is a difference in moisture content from one item to the other making it necessary to take additional steps to protect these items. For example, starched jelly bars, commercially known as gumdrops, have a very high moisture content -- around 14 percent. We have compressed bars in some of our rations, having a moisture content in the neighborhood of 3 or 4 percent. If wrapped with commercial cellophane, the moisture will migrate from the candy into the compressed bars, and the net result is that we have an unacceptable candy and an unacceptable compressed bar.

MR. BRONANDER: One of the complaints on the part of the machinery companies is that only a few people in the military are aware of the many different types of machines that are manufactured. To overcome this, the Packaging Machinery Manufacturers Institute has catalogued all of the machines, manufactured by its members, in a directory that is available at its New York office for the sum of ten dollars.

Mr. E. H. Cawley of the Philadelphia Laboratory of the Signal Corps is our next speaker.

MR. CAWLEY: The Signal Corps has embarked upon two programs. We call the first program "Packaging Cost Reduction Program."

This program is divided into three phases. The first phase is the use of semi-automatic packaging equipment for binnable type items. The Pak-Rapid machine is being used at the present time. The savings are tremendous when compared with the old hand operation.

The second and third parts of our program are involved in specification re-development. There is nothing new in re-development of specifications. Everyone concerned with military packaging is concerned with this problem. We found in our own operation that a great many of these specifications were written during the last war by people with limited training in specification preparation work. These war-time specifications have been under study and are now being revised.

We had, as one example, a shelter containing a radio receiver, sender, teletypewriter, and various equipment that is used in the field. It is enclosed in a metal and wood container measuring roughly 8 by 8 by 8 feet. We have had a lot of trouble with it, because we were trying to desiccate the pack and it wasn't holding the proper atmosphere. The access door was sealed with mastic. It had tape applied over the mastic which was boned in. All of the blackout windows and the roof were sealed off. We ran a series of tests and developed a new packaging procedure which is saving $114,000 this year in our procurement of this item.

We are continually attacking this program of re-development of specs through both the contractor and our own office. The people in my office are busy writing specifications at the present time. Unfortunately, they can only devote a certain amount of time to going back over what has been done before. However, we recently made a contract for the re-development of the most important specs moneywise.

Our program is divided into three phases. Phase I is the small binnable type items on which we are going to semi-automatic packaging machinery, and eventually to completely automatic equipment. Phase II covers packaging of radio sets and that type of equipment. Phase III deals with the very large items.

While working to effect a saving in procurement dollars, we also work on reducing in the weight and cube, which is even more important in time of emergency.

We have also a Signal Corps program which is being handled by the Industrial Mobilization people. It is the pre-printed circuit board.

I believe there are probably five manufacturers developing automatic equipment for assembling components to circuit boards, radio circuit boards, television circuit boards, etc. They take a pre-printed board and feed it into the machine. Then, depending on the system that is used, it may go through 20 or 30 operations, each in a different machine. One machine will assemble a tube. Another will assemble a resistor. The next one will assemble other parts, and so on, until the assembling operation is complete.

The Signal Corps, with General Electric, have developed one machine using one head which takes care of assembling everything under the board. In other words, it's a circuit. Instead of moving from one head to another and having components assembled to it, the board moves around. The machine does the complete operation -- one machine and one machine head.

We are still feeling our way where packaging is concerned. The problem at the moment is in sending the components, to be assembled, to the manufacturer in such pre-packaged state that it can be fed into the machine. There are various methods in use at the present time. Some companies package resistors using double tapes, tape over both ends, so that a roll can be placed on the machine so that it takes off one at a time. Another method uses simply one tape over the center. But there are many problems because your tolerances on the board are so small -- they are down to ten-thousandths of an inch. For example, when the machine assembles a resistor to the board, it has to be bent in such a manner that it will fit those tolerances. That is one problem we haven't solved for the reason that further standardization on the machine is necessary before you can set up packaging specifications to suit.

General Mills, United Shoe Machinery, and two or three others have these machines, but they are all slightly dissimilar so that packaging of components has to be arranged to suit each type. We can't ask the Radio and Television Manufacturers Association to come up with a certain type of packaging until we are sure of what we want.

In the first phase of redevelopment of specifications, we felt that we were packaging to protect the bag, not to protect the item. So wherever possible, we are eliminating cushioning from our bin type items. We are going to a crepe-kraft material which has a stretch to it. It is coated with a poly. There are two types -- one a mil and a half, the other six mil. We are also investigating, at the present time, a saran-poly combination. Saran will, of course, not heat-seal, but the paper company that is working with us is putting a mil of poly on top of the saran to give us our heat-seal.

MR. BRONANDER: Have you done anything in transparent packaging of bin items?

MR. CAWLEY: No, we haven't.

MR. BRONANDER: Do you think that there is an area in your --

MR. CAWLEY (interposing): I refuse to comment on that.

MR. FITZGERALD: Are you investigating possibilities of metalizing plastic film for packaging?

MR. CAWLEY: No sir, we are not.

MR. BRONANDER: Would you tell us about it, Mr. Fitzgerald?

MR. FITZGERALD: I am not an expert on metalizing plastic film, but from what I understand from (a) the suppliers of plastic film and (b) the metalizers, the index of resistance to moisture and vapor is increasing on the order of 10 and 20 to 1 by this metalizing of plastic film. It is a very interesting phenomenon because all you do is add about 3 to 5 microns thickness on the plastic film.

MR. CAWLEY: What does that give you in the way of a moisture transmission rate?

MR. FITZGERALD: I don't have the figures available but I think DuPont and Olin-Mathieson have them. They are working with the metalizers to explore the possibilities with this kind of combination as a vapor or moisture barrier.

MR. CAWLEY: One of the reasons why we went into poly and are going into saran is that in the next war foil is going to be something difficult to get. Because there are so many uses for foil, it just won't be allowed for packaging.

MR. FITZGERALD: I believe your physicals for metalized plastic are considerably superior to foil and, of course, you are not using as much metal as you use in foil.

MR. CAWLEY: Foil has been the standard method to pack in the military for so long that breaking away presents problems.

MR. FITZGERALD: There is always the question, will the plastic be available? I don't know. I think it is an interesting subject to probe because of the increased vapor barrier properties which apparently are being obtained by metalizing plastic film. Foil is an expensive material and we are looking for substantial reductions through the use of metalized plastic film.

QUESTION: Is the metal coating between the poly and whatever other substance is used?

MR. FITZGERALD: Yes. Apparently, if you want to laminate, the plastic film is outside and the metal inside; then it is laminated to another film. That gives you the vapor barrier.

QUESTION: Is that a rolled-on or sprayed-on process?

MR. FITZGERALD: I understand that it is done using a vacuum deposition process. It is vacuum metallurgy which is a well known science today.

MR. BRONANDER: Mr. John Attaway of Mid-States Gummed Paper Company will review latest developments in "skin packaging."

MR. ATTAWAY: Skin packaging is a relatively new concept in visible flexible or visible rigid packaging that was touched on briefly by Mr. Quinby from Grace Chemical. The concept is so new that there are still technical difficulties of a minor nature being ironed out.

To give a brief description of the method of packaging itself, the materials used could be cellulose acetate, the butyrate family, or the more rigid vinyls and a board coated with a thermoplastic adhesive. The board generally falls in the range of 25-30 point.

The method involved is principally one of heating and vacuumizing the film which is lowered from a rack over the part to be packaged. The heat above the rack activates the plastic film to a point of softness. When it is lowered upon the board, the vacuum is applied while the adhesive on the board's surface is activated also, thereby forming the vacuumized package. The package is rigid on the back side. Descriptive data can be printed in various colors on the board. It is rigid and fairly economical, while being a very good merchandizing package. It is used in display selling. When I say "economical," I mean it will range probably in the neighborhood of two to five cents, depending upon the size and the materials used.

MR. FITZGERALD: Is there a critical range of heating that plastic before you put it through the vacuum step?

MR. ATTAWAY: Yes, as far as the plastic itself, but more so with the board. If the temperature is too high, it will bake out the board so that you won't get proper adhesion. That will prohibit the use of films such as "Mylar" which requires a great deal of heat to properly activate it.

QUESTION: Does the thermoplastic adhesive on the board have the equivalent properties of moisture-vapor transfer and compatibility with the plastics you are using?

MR. ATTAWAY: No, sir; it doesn't because the film itself has to be mildly perforated to permit the vacuum to come through the board. Actually, the air under the film, once it is lowered into position over the product to be packaged, is removed by the use of a vacuum, and that comes through the board itself -- so that eliminates the air-tightness.

CDR BOWMAN: Is this material ever used in conjunction with any type of preservative on crinkled surfaces, say?

MR. ATTAWAY: No, sir; it is not. It is primarily for display purposes, merchandising, and packaging. It serves no purpose as far as protective packaging for military items is concerned. It cannot be on metallic parts that are subject to corrosion because there is a very high MVTR through the board itself, the back side of the package. Actually, the front side is resistant.

MR. CLAY: Suppose the board was treated?

MR. ATTAWAY: The board necessarily has to be slightly perforated -- that is, the coating of the board itself -- to permit the vacuum to be functionalized.

MR. O'REILLY: Has anyone applied that method to continuous automatic packaging?

MR. ATTAWAY: No; they have not.

MR. BRONANDER: Mr. Robert Farrell of the Marathon Corporation is our next speaker. I might say in the way of introduction that the Marathon Corporation not only makes packaging materials but also has a very fine machinery division with an excellent record of machine developments.

MR. FARRELL: Our company has worked primarily on food packaging. There are a number of new developments in food packaging that don't apply to military packaging.

The supermarkets, for example, have created the necessity for a lot of work on design. A great deal of research time is spent trying to predetermine what would be appealing to a housewife. That may seem like a very simple thing; but, when you talk to the people who made these studies, you will find that there are a lot of technical problems such as you have in military packaging.

As Mr. Putnam said yesterday, I think scarcity of labor and increasing labor costs have certainly helped to bring on mechanization. It has made our jobs in packaging more complicated.

I believe a great deal could be accomplished in military packaging by following through on Mr. Putnam's suggestion for a committee. It seems to me that once we become acquainted with the problems confronting the military, our experience with civilian packaging would enable us to make many worthwhile recommendations.

For example, there is a machine on the market for banding frankfurters together that might lend itself to the circuit board component packaging reviewed by one of the other speakers.

Another example can be found in the automatic packaging of ice cream in folded cartons. After observing hundreds of these machines in operation, you can't help but believe there must be applications within military packaging.

The packaging of frozen food is another example of an industry where technical progress has been very rapid and still forging ahead. The unique methods of packaging developed by necessity within this industry, employing relatively simple equipment, leads me to believe there are applications here that would interest the military.

Summarizing my remarks, I believe progress within the proposed committee would be measured to a great extent by the application of one packaging technique to specific problems presented for solution.

MR. BRONANDER: Toothpaste packaging lines are excellent examples of automation. All of the latest developments can be found here starting with the automatic unloading of the empty tubes from the tote boxes. Filling and closing the tubes; setting up, loading, and closing the cartons -- all of these operations are accomplished automatically. After leaving the cartoner, the packages are conveyed automatically to the bundling machine which not only collates the packages into groups of twelve, but also prints and code-marks the wrapping material as it unwinds from a roll. After being printed, the material is fed into position, cut to size, formed around the bundle, and then glue-sealed with heat to secure the folds of the bundle overwrap. All this is done at a speed of 240 individual packages per minute. The code-marking attachment imprints the date, the shift, the batch, the operator, and any other information using standard rubber or steel letters and numbers which are easily and quickly changed.

I believe military items will eventually be packaged on automatic machines modified to meet military specifications that have been revised by a committee, such as the one suggested by Mr. Putnam.

There are several new developments in foil packaging worthy of mention today. One of these projects has to do with the printing of adhesive on foil. Instead of using a foil with the adhesive or wax spread over the entire surface, some of the packaging machinery manufacturers are experimenting with printing units that will print adhesive on the areas of the overwrap to be sealed. Insect infestation and problems of sifting demand protection for the contents of those packages coming very close to that demanded in military packaging.

Vacuum packaging of meat products and cheese is becoming more and more popular with automatic machines now on the

market helping to bring the cost of packaging down to reasonable levels.

Another form of bundling is multiple-wrapping as illustrated by super-market six-packs of chewing gum and candy bars. In the case of chewing gum, the individual five-cent packages are fed into the machine at speeds of 720 packages per minute. These packages are collated in sixes and then overwrapped in heat-sealing cellophane.

While the number of parts or products to be packaged by the company, with a government contract, may be small in quantity, the problem can be compared with the Christmas packaging problem facing the company engaged in non-government activities. In both cases, it is difficult to forecast the quantity to be produced and packaged with the result that packaging machinery specifications are carefully drawn around equipment having greater production capabilities.

Private industry has turned to another form of inexpensive packaging -- namely, banding machines. Banding of two or more packages together for multiple-sales is on the increase, as a result of the popular 1-cent sales. Using a pre-printed band with a registered design, high-speed machines automatically collate bars of soap and other products into groups of two, three, four, or more before positioning and adhering the band to each of the items in the multiple-packs.

New developments are underway in the banding together of different size packages, such as a tube of toothpaste and a toothbrush. Other examples of this can be found in the food industry where premiums play an important part in the merchandizing of food products. It takes a bit of imagination, but you can find similar applications within the military.

Mr. Putnam's talk covered the wide experience gained by members of our packaging machinery industry and I can only add that we, as an industry, are ready to help in any way we can. It is up to the military to tell us what step to take next.

MR. O'REILLY: I think those of us attending today's session fall into two major catagories, the first being a supplier of soft or consumer goods to the military, and the second having to do with hard goods, spare parts, and the like.

Speaking as a member of the automotive industry, I would like to say I think the committee concept is a little ahead of us if it is dealing with automation. Automation, I believe, comes about after a high degree of mechanization has been reached.

In the packaging of military parts, it is my impression that those operations are far from mechanized. Seventy to ninety percent are still manual operations. Our major problem, as we see it, is not one of automation but of transfer from manual to mechanical means. This concept may not fit in with food-packaging people who are already at a highly mechanical state. While they are dealing with speeds of 1,200 per minute, we are working on a goal of 1,200 per hour. A contract calling for 1,200 different parts leaves little opportunity, due to the nature of procurement of spares, to apply major automatic set-ups because volume is generally restricted to a very small minority of the parts involved.

Our problem, then, is not to design mechanical systems for each part to be packaged but to devise methods that are applicable over a wide range of odd-shaped and different size parts.

If a committee is set up, I suggest that it start off dealing in generalities. I suggest it consider the following questions: First, how to recognize a problem; second, what are the ground rules for approaching the problem; and third, what is the procedure for bringing in the "experience" from industry or from the military to apply to the solution of the problem?

I think we need to consider what can be done with each of the component phases. In our own type of packaging that means rustproofing. How do you mechanize rustproofing, as such? How do you effect the best closures on containers? How do you print? What are the earmarks of an obsolete method of identification? How do you recognize the danger spots and sore spots? And how can you approach each phase?

When we have made a good start on that, we want to know how do you tie these phases in together. How do you get two operations together, get one piece of equipment that does both of them? So, you begin to eliminate these operations and then gradually we can approach the field of automation.

We want to review each military packaging method with the idea in mind of how does that method lend itself to automation -- or mechanization; let's go back a stage, mechanization.

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If it doesn't lend itself to mechanization, we want to find out how can we get rid of it. How can we get it out of our plant completely? Which of those methods do lend themselves to mechanization? And then, how can we exploit them most fully?

Forgetting the conventional present packaging forms we are permitted to use under the specification, how do we exploit new package forms, some of which we have seen in here today? How do you get those "in the mill?" How can you use them without waiting for two or three years that is inevitably necessary to get approvals on them? How do you test them faster and better?

I think we have an educational training problem on our hands, training more and more people to think in these terms. I think it could well be done in a place like Rossford, where you have a concentration of both industry and military people dealing with this question.

These are a few points from the hard goods manufacturer's standpoint.

MR. OLSON: I would like to try and define for a moment this word "automation," which has come to be a catchword or a fad in the minds of many people; unfortunately, with a lot of fairly serious connotations in that a good many people are thinking of automation as some mysterious or weird bunch of automatic factories with push-button control. Automation, to my way of thinking, is nothing more than mechanization. So, this business of automation is nothing more than a catchword or a term that has developed from our Industrial Revolution; or a replacement of human effort by mechanical effort or manufactured energy.

In the pharmaceutical industry, we run into very severe problems with the discovery of a new wonder drug which starts out as liquid gold in the research laboratory, each unit being terrifically expensive and valuable. It is perfectly realistic to package each unit by hand at that point in the process. But as our manufacturing knowledge and techniques improve and we are able to produce this antibiotic or new drug for the millions of people throughout the world that need it, you are forced to an extremely rapid rate of mechanization. It is not easy, as some of the problems are extremely difficult; but you have no choice except to go ahead.

We have found in the pharmaceutical industry the things which we had previously thought not susceptible to mechanization have been mechanized. We have an operation where we subdivide extremely minute quantities of antibiotics, to permit proper dosage for the patient. Extremely fine tolerances are required in controlling the operation. It took us a number of years to develop the equipment that would perform this operation at some reasonable pace to meet the large demand. Antibiotics are now available at reasonable prices. However, we believe they can be made at still lower costs by extending our knowledge and experiments to mechanize more of the operations that are currently done manually.

MR. MARTIN: Mr. O'Reilly referred to an "evolution" from manual to mechanization to automation. I wondered just what we would draw there, whether it was a very firm line or rather a line with shades of gray.

MR. O'REILLY: I could only conjecture an answer on that to the effect that it would probably be a matter of shading and a matter of evolution that probably goes on in front of you without your being particularly aware as to when you pass from mechanization into automation.

MR. MARTIN: I thought perhaps you had a pretty concrete picture with your experience of where the one let off and the other was taken up.

MR. O'REILLY: Let me picture for you a dramatic contrast involving packaging. You have been watching a fully automatic manufacturing operation involving no direct labor and very little indirect labor. It is the pride and joy of all the engineers and the top executives of the company. From the first operation to the last processing stage, it was intensely automatic and a wonder to see. But the minute the unit was finished and ready for packing, it was handled exactly the way it had been done for twenty years. The contrast at that point stood out like a sore thumb. This problem will be corrected, but the contrast was very dramatic.

MR. BRONANDER: I would like to point out that the military does not have the competition angle that private industry has. I have seen many instances where a firm did not want to invest in automation but had very little choice.

We do know that the military is interested in cutting costs, and installations where labor is not available or scarce, mechanization is the only answer. We believe there are places throughout the military establishment where equipment that is now manufactured can be put to work effectively.

We know that semiautomatic equipment is the first step. You are going to have to work with machinery people, eventually, so I suggest you plan to investigate the equipment described here today and prepare a "mechanization" program for cutting costs and stepping up production.

MR. CAWLEY: I think that the military has an equal burden placed on them at the moment because of their interest in the reduction of cost. I believe it is equally mandatory with civilian enterprise that they reduce costs by going into automation wherever possible.

If you are planning to establish a committee, you might at an early stage get a definition of "automation" and "mechanization" so that we won't have synonyms all the time.

MR. FARRELL: We have seen unusual things happen in our segment of the packaging industry. You might see a completely high-speed automatic piece of equipment and not have the volume to support it. But many times, you can take parts or mechanisms from that unit and adapt them to your operation. I offer the suggestion that parts of existing equipment could do some of the jobs described today.

When you talk about mechanizing operations, you talk in terms of a great deal of money. We have had a lot of cooperation from the packaging machinery people in our industry, and are appreciative of their position. Developing machinery is very expensive. In many cases, it has been hard to develop interest. To determine the degree of calculated risk, we often do the mechanical development ourselves. However, we do not build any equipment. When we develop something mechanically that solves a problem, we ask one of the machine companies to build it. When you get into mechanization, progress is slow because it is time-consuming and expensive.

MR. BRONANDER: We planned to close the meeting promptly at 11:45. If there are no other questions or comments, I will declare the meeting adjourned.

Thank you very much for coming.

(Whereupon, at 11:45 o'clock, the meeting was adjourned.)

Morning Panel Session

Wednesday, October 12, 1955

A4. Consolidation of Cargo for Shipment
Chairman, Colonel Charles A. Nebel, USA
Chief, Field Services Branch, General Traffic Division
Office of Chief of Transportation

Recent military and industry developments.

Cargo Transporters in CONEX Service

Mr. R. L. Vekroff
Conex Control Agency, Office of the Chief of Transportation

When we speak of cargo transporters in CONEX service, we refer to the Army's standard shipping container, which we call a "cargo transporter," operated in a world-wide "container express service" — a term which we have compressed to the code word, "CONEX."

The fundamental purpose of our cargo transporters is to reduce our mountains of small package shipments to homogeneous unit loads of optimum size for the direct application of mechanical handling equipment with a minimum of human labor.

There are two very compelling reasons for the Transportation Corps' efforts in adopting the cargo transporter.

First: 42 percent of all the dry cargo which the Army ships oversea is composed of small packages. When we handle this portion of our cargo in the conventional fashion — package by package — we are undertaking an enormous task of man-handling at every depot and transshipment point in a great variety of long supply lines. We use mechanical handling equipment in such operations, but we do not achieve mechanical handling of cargo. Individual small packages must still be man-handled into groups to permit the application of the mechanical equipment. In conventional cargo-handling operations, we find efficient application of mechanical handling equipment only in the continuous mass movement of bulk commodities. Only a minimum of human effort is required for controlling the mechanical equipment used for handling such cargoes; there is no application of human labor to the cargo itself. The cargo is homogeneous, and the handling equipment — pneumatic, belt conveyor or grabbing equipment — is designed for direct application to the cargo.

With our cargo transporter, we seek an approximation of such handling methods for our small package shipments. (The cargo transporter is not the only medium in our efforts. Some of our small package cargo — approximately three-eights of the 42%, or 16% of all dry cargo shipped — can in most instances be moved more economically by banding packages onto pallets and preserving the integrity of the pallet-loads from origin to destination. However, the other five-eights, or 26% of all dry cargo shipped, can best be moved in our cargo transporters, which are the subject of my remarks.)

The second compelling reason for our adoption of the cargo transporter stems from the new logistic concept which may briefly be summarized as providing for maintenance of small stocks of supplies in mobile form for prompt shipment to forward points wherever required. Under this concept, modern transportation and communication facilities must be exploited to achieve flexible supply operations responsive to the rapidly changing situations which will beset any combat operations under anticipated future conditions. The utility of cargo transporters in supply and transport operations conforming to this concept will be evident from my later remarks.

Our cargo transporter weighs 1,500 pounds (some weigh 1,430 pounds) and measures 365 cubic feet gross on the following dimensions: length 8'6", width 6'3", height 6'10-1/2". Access is by a double door across the width of one end. The cargo transporter has a cargo capacity of 9,000 pounds in 295 cubic feet. It is fitted with skids and with lifting rings located at the top four corners. Loaded cargo transporters may safely be tiered three high, with the skids of the upper transporters resting in recesses in the roofs of the lower transporters. The loaded cargo transporter can be handled by a 15,000-pound capacity fork lift truck, by cranes of suitable capacity, and by the cargo falls as usually rigged on the ordinary cargo vessel. The transporter can be carried in an Army six-by-six truck; three transporters can be carried in the usual military or commercial flat-bed or open-top semi-trailer; from six to eight transporters can be carried in the various sized flat and gondola railway cars used in the United States. Empty transporters can be tiered two-high on flat cars for movement over routes affording sufficient clearance. The transporter is suitably sized for economical movement in foreign gondola and flat cars.

Stowage of cargo transporters in trucks and in flat or gondola railway cars presents no notable problem. Transporters have been loaded in box-cars, but such stowage is cumbersome and incompatible with our efforts toward mechanized cargo movement with minimum application of human effort.

For ocean movement, the ideal stowage of cargo transporters is in the squares of vessels' hatches, where the transporters are immediately accessible by vessels' ordinary cargo falls. Some lateral movement below decks for stowage is feasible, and will be assisted by the development of a suitable pallet-jack which is already in progress. It is evident, however, that if it is attempted to stow too many transporters in a vessel, space will be lost around stanchions,

fittings, and the fairing of vessels' sides. It is calculated that 176 cargo transporters can be stowed in the squares of the five hatches of a liberty ship. 598 transporters have been loaded in a victory ship. This was close to the maximum quantity of transporters which could have been put in — and on — the vessel. The vessel was filled out with loose cargo.

The weight, bulk, and construction of cargo transporters necessitates that they always be handled and stowed top side up. This necessity is a guarantee that cargo loaded in transporters need only be stowed reasonably tightly, but without bracing or dunnaging. However, when very small packages are loaded in a transporter, it is desirable to fit planks across the doorway to preclude the load from shifting against the doors.

In addition to providing a solution to the problem of mechanized cargo handling, cargo transporters have many other advantages; for example:

Strong protection against loss, damage and pilferage of cargo.

Complete delivery of lots or sets assembled in the transporter.

Easier collection and forwarding of miscellaneous small shipments.

Faster sorting and distribution of supplies at transshipment points and destinations.

Reduction in weight and volume of packaging. (We often find that this reduction is greater than the tare weight and volume of the transporter.)

Our cargo transporters are operated as a single fleet, centrally controlled in the Office of the Chief of Transportation, for use in world-wide service. The Air Force has recently become a participant in the CONEX service by providing funds for purchase of some of the transporters in the fleet. All cargo transporters, whether owned by the Army or by the Air Force, are pooled in the single CONEX fleet and are equally available for Army or for Air Force shipments.

Transporters are loaded wherever and whenever required. Requirements are fulfilled by routing empty transporters to meet the demands prevailing at the time they become empty, with the objective of minimizing pools of idle transporters

and cross-hauls of empty transporters. Cargo transporters thus have something of the nature of "vehicles" or "carriers" and are constantly moving in varying and unpredictable itineraries.

The organization within the Office of the Chief of Transportation which is responsible for the cargo transporter, the "CONEX Control Agency," is now staffed by Air Force as well as by Army personnel.

Based on brief, coded reports electrically transmitted to it by every installation which receives or dispatches cargo transporters, the CONEX Control Agency maintains records which continuously reflect the lading, current location, and destination of each cargo transporter, and the volume, speed and direction of cargo transporter traffic with respect to each installation in the traffic pattern. These records presently enable us to maintain a simplified property accountability for the cargo transporters, monitor their utilization, and plan their timely and economical placement for loading. It is obvious that by additionally relating our records of cargo transporter movements with shippers' detailed records of transporter ladings, we will have a potent instrument for achieving the flexible and quickly responsive supply operations comprehended in the new logistic concept which I mentioned earlier.

Control of a transporter fleet of the size now in existence and contemplated for the immediate future is well within the capacity of the records system now being maintained manually. However, the system was designed to permit the introduction of electronic equipment whenever necessary. We can now foresee the future scope of the system in assisting the control of supply operations as well as in controlling the movements of a large quantity of cargo transporters. We are therefore proceeding with plans for adopting electronic equipment.

The principal use of cargo transporters — the principal CONEX traffic — is in the movement of military supplies from the United States to our installations and units oversea — what we call "troop support cargo." Cargo transporters are loaded either at inland supply depots in the United States or at ports of embarkation or other collection points, where miscellaneous small shipments are consolidated into transporter loads. Similarly, upon arriving oversea, cargo transporters may be emptied or their contents either at points to which full loads are consigned, or at designated bulk-breaking points which subsequently forward individual small shipments to the respective local consignees.

Oversea installations which receive the cargo transporters may provide return loads comprising military material or household goods of personnel returning to the United States. If no return loads can be provided by those installations, the transporters are returned to an oversea port, where they are loaded with baggage of personnel returning to the United States, or with A.P.O. parcel mail for discharge upon arrival at a United States port. Very few cargo transporters return empty to United States ports. The carriage of A.P.O. parcel mail has reached large proportions and has been enthusiastically welcomed by both military and civilian postal authorities because of the better protection afforded to the bamboo fishing rods, china-ware, and innumerable other items, all fragile, which our soldiers continually send home.

In addition to carrying return loads immediately after they are emptied at oversea installations, cargo transporters may also be used for the movement of supplies between installations oversea. The use of cargo transporters for shipments between installations in the United States has not yet been authorized because greater savings can be achieved by dispatching transporters over routes which involve a large number of transshipments — that is, oversea supply routes. Most shipments between installations in the United States involve handling cargo directly between a warehouse and a railway car or truck positioned alongside the warehouse, both at origin and at destination. Interposing cargo transporters in such shipments would result only in double handling: loading cargo into the transporter, then loading the transporter into the vehicle, and reversing the process at destination. However, we find that there are some domestic shipments in which cargo transporters can achieve notable savings in handling and packing costs. When such savings can be demonstrated, transporters will be used.

Apart from the regular traffic in troop support cargo which I have described, cargo transporters are also being used for movements you have been hearing about lately: "Operation Gyroscope" — the return of large units from oversea and their simultaneous replacement by units from the United States, with concurrent movement of dependents. Cargo Transporters are carrying the household goods of the personnel involved in this operation. A similar employment to which cargo transporters are increasingly being put is the movement of military equipment which accompanies units moving between the United States and oversea locations. This, in turn, points to an important scope of transporter operations being planned for the future: the storage of selected items of mobilization reserve supplies, and the advance positioning

of the minimum quantities of cargo transporters which would be initially required by organizations designated for immediate movement in times of emergency.

Implicit in both our present and our planned future operation of cargo transporters under the new logistic concept is the mechanical handling of cargo in uniform transporter loads to the farthest forward areas in which mechanical handling equipment can be operated, in war as well as in peace-time. Within this limitation, cargo transporters will provide easy identification and accessibility of supplies, and also continued mobility and protection of supplies. Under this concept, "warehouses" will be as mobile and as available as the supplies they contain. The transporters will be the "warehouses." Requirements for heavy packing of supplies and for acquiring fixed covered storage space will obviously be reduced. There will be one additional requirement. We have already made considerable progress in meeting it: the development of a fork-lift truck capable of handling loaded cargo transporters over the rough terrain where we would expect to disperse our loaded cargo transporters in forward areas closely supporting combat operations. To any objection that the employment of heavy mechanical handling equipment in forward areas would be cumbersome, we have a ready answer: we no longer fight wars with bows and arrows.

It is evident that the route over which any transporter will travel can not be foretold. Whenever and wherever a cargo transporter is emptied, it will be dispatched subsequently to meet whatever demands prevail at that time and place, in a manner similar to the operation of tramp cargo vessels. However, the United States ports of embarkation can be identified as the one smallest group of installations through which all cargo transporters will pass with the greatest mean frequency. These ports are focal points of the entire cargo transporter traffic pattern. Moreover, they now are, and presumably will continue to be, the principal points from which empty cargo transporters will be forwarded to inland United States installations whenever the quantity of transporters forwarded inland with loads is insufficient or is improperly distributed to fulfill requirements for export loading. Also, an appreciable portion of cargo transporters is loaded at the United States ports of embarkation and is again dispatched oversea without moving inland at all.

In summary, and with particular consideration of the relevance of our operations to commercial interests: our cargo transporters are more than "packages"; they have something of the nature of "vehicles" or "carriers." They permit

safe movement of lightly packed supplies from source to final destination without breaking bulk, in what might be called a continuous voyage over land and sea from shipper to receiver, under whose supervision the cargo is loaded and discharged. The cargo is handled only by the cargo interests; carriers and transshipment points handle only a sealed shipping container. Excepting the rough terrain fork-lift truck which is being developed for purely military purposes, no special equipment is needed for moving or handling cargo transporters.

With relation to actual carriers — trucks, railways, steamships — the loaded transporters are uniform items of cargo which can be quickly loaded, unloaded, or transshipped with little likelihood of demurrage. The factors giving rise to demurrage, which are usually attributable to delays of shippers or receivers, are operative only on the transporters themselves, not on the vehicles or vessels which carry them.

In our CONEX operation, the functions of shipper, carrier, transshipment point, cargo receiver, and operator of the transporters are all integrated within the Army transportation system. It is to be noted that no one interest within this system — shipper, receiver, or carrier — could by itself operate transporters with any assurance of prompt forwarding of loads to final destination, or economical return of transporters, usually with return loads.

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Consolidation of Cargo for Shipment

Mr. D. J. Collins
Pennsylvania Railroad

Gentlemen, it is a pleasure for me to speak to you today in connection with Pennsy TrucTrain Service.

Superior service of motor carriers and in many cases lower cost of transportation by those carriers has resulted in serious loss of rail freight traffic. Since the end of World War II, the railroads in the United States have found their participation of all available traffic gradually dwindling. The Interstate Commerce Commission in their reports of inter-city traffic handled by railroads has shown a steady decrease; for example, in 1946 the rail carriers in the United States handled 67 percent while the motor carriers that year handled 9 percent. Six years later in 1952 what happened? The rail carriers' participation slipped from 67 percent handled in 1946 to 55 percent while the highway carriers had a healthy increase from 9 percent to 16 percent.

Now, I do not think it is necessary to tell you that we are confronted with a competitive situation which has been permitted to grow because of the subsidies granted to the highway carriers. Their subsidies are mainly in the form of favored tax treatment and inequities in our laws which permit the motor carriers to operate under regulations of the Interstate and State Commerce Commissions which are more favorable to the trucks than the laws and regulations prescribed for the railroads.

We are striving to place the railroads in a more favorable position by seeking changes in the various laws and regulations. But these changes will not accomplish everything to place us in the position we are seeking. We must offer to our patrons the service which they demand under present day conditions. One of the most important steps in that direction has been the establishment of TrucTrain Service, which was inaugurated in July of 1954.

The idea of hauling highway trailers on flat cars is not new. In fact the first highway carriers' trucks to be hauled on flat cars were in the late twenties between Chicago and Milwaukee by the Chicago North Shore and Milwaukee Railroad, an electric line. Their service was limited to L.C.L. freight. Later, the Chicago and Great Western inaugurated in 1936, a service between Chicago and Minneapolis — St. Paul which was confined to hauling the over the road common carrier trucks. This was later adopted by the New Haven who

perform the service between New York, Boston, and Providence. Our TrucTrain service, however, was a radical departure from other trailer on flat car arrangements just mentioned. TrucTrain service offered to our patrons the same truckload rates and competitive service as offered by the over the highway common carrier.

Now, this may sound simple and easy, but I assure you it was a job of great magnitude to determine just what rates the motor carriers published that were necessary for us to meet the competition rate-wise. We found that while many trucks observed the same rates on a given commodity from New York to Chicago, for example, we found that those carriers that names the same rate did not handle the particular traffic but that it was handled by a relatively small operator publishing a lower rate by a cent or two per hundred pounds. A good example of this was found in the case of green coffee from New York to Chicago. We initially published what we thought to be the going truck rate, that is the lowest truck rate, but later found that a single motor carrier published a lower rate and that carrier was handling the traffic. We found that we could handle the coffee on the lower rate and make a profit and we promptly made publication. The particular receiver was located approximately a half mile from our team tracks at Chicago and as a result of our TrucTrain rate we were able to get this business. Without our TrucTrain service I am afraid the Chicago receiver would continue to handle his coffee in over the highway service and we would simply continue to remain out of this business in our conventional box car service requiring team track delivery.

As you can appreciate the step in establishing the TrucTrain service was a big one and I must admit there were a lot of skeptics within and outside the railroad circles who felt we would not make a success of the venture. However, there were some of us who felt we were on the right track because our traffic studies showed a vast potential available to our railroad represented in traffic originating and destined to points not located on rail sidings which had been lost to the highway carriers and that had formerly been handled over our team tracks. We also found that the low minimum weight offered by the motor carriers induced many shippers, including many served by rail sidings, to use that form of transportation in order to maintain lower inventories. Those advantages coupled with the speed and flexibility of the over the road trucks created a competitive situation which simply could not be matched in our conventional rail service which had been lost to the highway carriers and had formerly been handled over our team tracks. We also found that because of

the lower minimum weights offered by the highway carriers many patrons including those located off track and those served by rail sidings favored trucks as it enabled them to make smaller purchases and maintain smaller inventories.

When we started our service in July of 1954 we converted 90 fifty-foot flat cars to handle our trailers — one trailer to a car. Later on as the traffic increased we equipped 25 additional fifty-foot cars. We now have, in addition to the 115 fifty-foot flat cars, 500 seventy-five-foot flat cars especially built for the purpose of hauling two trailers to a flat car. These flat cars are equipped with cushion draft gears and roller bearing journals.

We have expanded our ownership of trailers from 150 to 283 trailers. We have van-type trailers — and also insulated vans, open top trailers with tarpaulin covers and flat bed trailers with tarpaulins. The flat bed trailers and open top trailers are used for handling shipments that require overhead crane or fork lift truck loading. We have just placed an order for an additional 150 trailers divided equally between open top trailers and flat bed trailers. When we started our service due to State weight laws we felt it inadvisable to purchase tandem axle trailers; however, since that time the laws have been changed and we are now in the process of converting all of our single axle trailers to tandem axle trailers. The short trailers with which we originally started are being replaced with longer tandem axle trailers and all recent purchases and future purchases of trailers will be of the tandem axle construction.

We also have available to lease for our own all rail bill of lading service, that is the service that the P.R.R. performs from beginning to end, those trailers that are owned by Rail-Trailer Company who act as an intermediary between the P.R.R. and the motor common carriers. We have leased as high as 40 to 50 trailers per week from this organization which allows our operation to be much more flexible.

Generally speaking, in most of the terminal areas in which we operate, we employ those local cartage companies who are performing our L.C.L. pick-up and delivery service or our line haul substituted freight service. In some cases the local trucking companies who perform this service are subsidiaries of our Railroad.

Our trailers are owned by the Excelsior Truck Leasing Company, a subsidiary of the P.R.R. from whom they are leased.

The all rail bill of lading service as I mentioned before was inaugurated in July, 1954. Originally the service was in operation between Chicago on one hand and Pittsburgh, Philadelphia and New York on the other. We found that there were very few trailerloads originating in the heart of Philadelphia going to the heart of Chicago; for example, the terminal areas of these cities involved were rapidly expanded to include the outlying industrial areas that we could legally serve. The first additional point added to our service was on November 14, 1954, when we added St. Louis and the Wheeling-Weirton area in the Pittsburgh District. On March 1, 1955, we inaugurated the service to and from Cincinnati, Ohio. Due to the long trucking required to pick ups in the Wheeling-Weirton area, a ramp was established at Mingo Jct., Ohio on April 12, 1955. On June 14, 1955, the terminals at Louisville and Indianapolis were opened. Our latest expansion occurred on September 25, 1955, when the points of Cleveland, Akron, Youngstown, Dayton and Columbus were put into operation.

Back in March of this year we experimented with the handling of LCL at rail rates in our TrucTrain service. This has proven so successful that we are now expanding this method of transporting LCL where we have sufficient available empty trailers, thus eliminating an empty return movement and making box cars available for carload freight.

In the first 8-1/2 weeks of operation in our own service we handled 114 loaded trailers. The peak week to date has been 409 loaded trailers and we have handled as many as 1,523 in one month. This has not been a simple job to regain traffic which has been lost to the Railroad over the last 25-30 years, but by doing a better job by all standards we are making a steady growth.

We have experimented in the interchanging of trailers to a limited extent. We have handled in conjunction with C&NW RR the movement of black powder from the Badger Ordnance plant at Baraboo, Wisconsin, to Charlestown, Indiana. By the first of the year we expect to publish a tariff in conjunction with the C&NW RR for handling of trailerloads on through rates. We are also working with otl railroads in this respect.

Our motor common carrier service was inaugurated March 3, 1955, between Chicago on one hand and Philadelphia and New York on the other. This service has been expanded to St. Louis and Pittsburgh and the volume of traffic has increased from 651 trailerloads in March to 2,261 in September.

On November 1 the P.R.R. and the N&W plan to inaugurate the first joint motor common carrier operation. This service will be between the Roanoke-Bristol area on one hand and New York, Jersey City and Philadelphia on the other.

Loss and damage in TrucTrain shipments have been spectacularly low. Up to the end of June 1955 the total claims paid came to 21-1/2 cents per $100 gross revenue or about 1/7 as much as for general freight traffic.

Our investment in terminals including those under construction is approximately $750,000. Our approximate investment to both converted 115 class F-30 fifty-foot cars and building new 500 class F-39 seventy-five-foot cars is $6,146,925.

As I mentioned before the job of getting shippers to try out our service has been one of the most difficult sales jobs our railroad has ever been faced with. However, 70 percent of our users in our all rail bill of lading service are repeat customers which proves once they have tried it they like it.

Here are some of the reasons why industry is turning to Pennsy TrucTrain Service. We are now in a position to offer a complete transportation package. We have passenger service, carload service, LCL service and now trailerload service. We have very few claims. The availability of equipment has enabled us to secure traffic when the regular trucking companies are not able to produce. In most instances we perform more quickly and with greater regularity. We know when the trailers are to arrive and call the consignee the day before arrival so that we may arrange delivery to fit in with the consignee's unloading situation on that particular day. Many shippers would prefer to deal with the railroads who are handling their bulk commodities in order to provide the railroads with some of their higher rated traffic with the hope that through added income the railroads would not be forced to seek general increases in carload rates as they have been forced to do in the past.

The "Safety Van"

Mr. Thomas Houston
Executive General Agent, A. H. Bull and Company, Inc., Washington, D. C.

Development of Containers and Vans is a matter in which my company is well versed. Our explorations into this form of transporting merchandise has ranged from Containers to Trailers.

We feel that in the use of container type transportation, we are one of the pioneers in the industry. More than seven years ago we initiated container service in our trade to Puerto Rico. Today, we have approximately 625 containers with approximately 275 c/f capacity in service. Initially, these containers were provided for protection of cargo. We operate in a trade where packaging of merchandise in good substantial export packing is nil. In their efforts to reduce transportation costs, shippers being desirous of making deliveries at the lowest possible cost have constantly reduced packaging until today packaging is purely on a domestic level at best, and in many cases, substandard.

Pilferage loss and damage under such conditions are naturally abnormal. Our containers provide protection from such losses in addition to eliminating completely packaging and marking if shipper so desires; since it is practical, some shippers actually use containers in that manner.

As demands grew for the continued and expanded use of containers, our thinking was continued along lines of improvement. Several years ago, we thoroughly explored the field of carrying trailers. This may sound as a detour since the subject is "Safety Vans," none the less, as ground work for my remarks some phases of it must be discussed.

Our trade is what might be called a "Tailored Trade"; in other words, while we have fairly heavy movements of traffic that do not naturally lend themselves to containers, our bulk is package goods of every description in every conceivable kind of package. Additionally, our trade in Puerto Rico is composed of thousands of individual, merchants for the most part, all dealing direct with their principals in the States. Operating as we do in a short haul trade with emphasis on frequent and scheduled sailings, our arrivals are timed to meet the markets; so much so that commercial warehouses are practically non-existant — most merchants carry very limited stocks or inventories. They rely completely upon our three sailings weekly from North Atlantic ports to supply their needs on a weekly basis of inventory for the most part.

This means, therefore, that the size of Containers or Vans was all important and that Trailers or roll-on-roll-off type of operation was impractical since few if any merchants found it necessary to carry inventories. Additionally, from a practical point of view, no one can deny that the carriage of wheels involved in such an operation consumes cubic capacity. It is not my contention to make a case against trailers, or roll-on-roll-off operations in other trades, but it is my point that in our trade, unbalanced as it is, we definitely found after searching investigation that trailers are impractical.

Having Containers of 275 c/f capacity and in quantity — having decided that trailers were impractical in our trade, we then came up with what we think is the practical solution — a Van, 15 feet long, 8 feet wide and 6 feet 10-1/2 inches high. Outside measurement. Also, these vans are especially constructed to provide maximum protection agains the rigors of ocean transportation.

As I have stated, our investigation and exploration in this field was very thorough. We came up with the idea of the 15-foot size from several practical points:

1. A Van most suitable to the needs of our trade and within a size where it would be in demand by our shippers and consignees based on their volume. Additionally, as I will cover later, a packaged unit from one shipper to one consignee is the most efficient type of operation. It would hardly be practical to have the Van unit far beyond the needs of one shipper or one consignee.

2. We found that this size was most convenient for adaptations to our present modern fleet without extensive ship gear alterations and permits us to haul more freight per square foot or cubic foot than if we were to limit the ships to Trailer Capacity.

3. In our trade, several hundred individuals earn their livelihood operating their own trucks. Trailers are not their standard equipment. Strange as it may seem, on our principal services from New York, the number of trailers seen indicates beyond any doubt that the average shipper is better equipped with stakebody or bobtail trucks than trailers. Roads in Puerto Rico present a similar problem.

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Therefore, our Van was tailored to meet all of these requirements. From a service standpoint to shippers or consignees, our Containers and Vans offer a quick efficient transportation package. Our Vans have a cube capacity of 688 c/f and a net weight capacity of 20,000 pounds, gross 23,900 pounds. They are equipped with standard doors on one end and one side to provide for end or side door loading. They fit one on the average stakebody or bobtail truck. The average 30-foot flat bed trailer can carry two.

They can be loaded at shipper's plant and delivered direct to consignee's store door. Shippers can assemble merchandise at our terminals and we will load containers or vans at a nominal charge.

Shipments moving in this manner afford perfect protection from loss by damage or pilferage; costly waiting time on truck lines is completely eliminated as vans are received and delivered in special areas and are loaded or unloaded immediately from and to vehicles by our own mobile cranes, without charge. One lift and a package of 688 cubic feet or 20,000 pounds net loaded is received or delivered by us in a matter of minutes. Scaled out on a per one-hundred pounds basis and compared with local cartage rates, the savings are considerable in this item alone. There are other advantages to the shipper, of course, not the least of which would be a saving on insurance. Our Van shippers have informed us that when advising their underwriters that their shipment is to move in a Safety Van, reductions have been made on their marine insurance.

We have provided heavy duty equipment at all our terminals for loading and unloading.

Last, but not least, there are no restrictions on packing for shippers to be concerned with. If a commodity lends itself to no packaging that cost is completely eliminated for the shipper.

Consignees eliminate the need for piece by piece pickup. His entire shipment is intact on arrival. In a matter of minutes, he also has had delivered what might have taken hours to load under other conditions — and best of all, his favorite truckman or his own vehicles can pick up this Van — whereas, if Trailers were involved, either the steamship company must engage in the trucking business to furnish automotive power or specialized truckers must be employed to the exclusion of any number of individual operators.

Our conclusions seem to have been proven sound as experienced by the continued and growing demand for Van Service, and we are constantly placing more in service as demands warrant to fulfill trade requirements.

Consolidation of Cargo for Shipment

Mr. F. G. Freund
American Trucking Association

The overall presentation insofar as the motor carrier industry is concerned on consolidation of shipments will be my portion of this discussion. The technical phase of the presentation, packing and so forth, will be that of Mr. N. F. Behme, who is Chairman of our National Classification Board.

The term "consolidation" is an interesting one in the motor carrier industry for the reason that we handle a considerable number of small shipments. By small shipments I mean those weighing 300 pounds and less.

In 1953 the Interstate Commerce Commission released a study of small shipments covering the year of 1951. It is estimated that in 1951 there were approximately one and a half billion freight shipments of 300 pounds or less transported in the United States. This was equivalent to almost 730,000 for every hour worked or about ten shipments per capita for the year. Of this total the Class I motor carriers of general commodities hauled about ten percent of the shipments, 21 percent of the pieces and almost 50 percent of the weight. Each of these totals was higher than for any other transportation agency except Parcel Post. On the other hand only about 18 percent of the total revenue from these shipments went to the motor carriers, whereas the Railway Express agencies received about 25 percent and Parcel Post about 46 percent. From this it can readily be seen that the trucking industry was getting a good proportion of the small shipments.

To emphasize the importance of the small shipment to the motor carrier industry, 60 percent of the total shipments received and transported by the industry weigh 300 pounds and less. Those weighing up to 600 pounds account for 65 percent of the total shipments and those weighing up to 1,000 pounds account for 86 percent. The average weight per shipment, in this category is 300 pounds. This is further significant when consideration is given to the fact that those shipments weighing under 1,000 pounds constitute 40 percent of the total motor carrier revenue.

There have been occasions in the past, through proceedings before the Interstate Commerce Commission, when the entire question of small shipments was considered and they were defined as being shipments weighing 300 pounds and less.

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The latest proceeding was instituted by the Commission on its own motion and involved motor carriers as well as railroads. The case was decided without a definite recommendation as to the solution to the problem.

In that proceeding the motor carrier industry advocated the consolidation of small shipments by restricting the number of packages of shipments weighing 300 pounds and less to two with a charge for each package over two.

Consolidation of the small shipments would mean to the motor carrier industry greater efficiency in the operation of platforms at terminals, reduced handling expense, would cut expenses on pickup and delivery, billing and collecting, and facilitate loading of linehaul vehicles.

In a recent survey made by an independent engineering firm for the industry on the matter of handling these small shipments, it was found that the inefficient use of labor was a luxury item.

While the recommendations of the motor carrier industry in the small shipments case were not adopted, it is pertinent to note that the consolidation of these shipments would in effect make for more economical handling on the part of the motor carrier industry by enabling it to cut down pickup and delivery, claim, billing and handling expense.

The overall picture insofar as the type of equipment constitutes a very complex problem for the trucking industry. It is practically self-evident that if consolidation of shipments and some of the intricate problems in connection therewith could be worked out there will be opportunities for considerable savings on the part of the industry.

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Consolidation of Cargo for Shipment

Lieutenant Colonel Alex Felker
Directorate of Transportation, Department of the Air Force

I will discuss with you consolidation of cargo in the Air Force. We like to call it unit loading. I will touch briefly on some programs we have participated in; discuss in some detail the unit load program presently in being in MATS, and, finally, give you some idea of what we are doing in this field.

At the outset let me say that we strongly subscribe to the unit load principle and are exploiting this principle vigorously. Our ultimate goal is to develop a cargo handling system that will permit interchange of cargo among the several modes of transport without reshaping of loads.

In 1953 we established a project which called for the movement of dry stores subsistance in unit loads to all stations in NEAC during the 1954 shipping season. Because of NEAC's enthusiastic reception we repeated this year. Let me say here that the project was possible only because of the complete cooperation of the Army.

The Army has already adequately covered the CONEX Control Agency, in which we participate, so I will not belabor that subject.

Early in 1954, MATS implemented a test palletization program in its PACD area of operations. It is the results of this test that I wish to discuss in some detail.

The purpose of the test was to explore the benefits available to the Air Transportation System through this method of unitization; to determine the problems that would be posed by palletization for air shipment; and to evaluate the characteristics that are desired in a pallet designed for this purpose.

Travis AFB was selected as the APOE for the formal study. Two thousand test pallets, 40 x 48 inches, 4-way entry made of light-weight wood were procured. A limited number of sides to be used in fashioning box pallets were also purchased. Pallets were stressed to carry a 2,500-pound load and weighed about 31 pounds. They were considered expendable but were generally expected to survive three to five uses. The general plan was to ship from Travis to Far East stations and the receiving stations to use them for the return of mail and cargo.

Cargo was placed on pallets according to priority and destination. Only cargo destined for a single point was placed on a pallet. Normally, only cargo of the same priority was unitized on a single pallet. However, when there was insufficient cargo of the same priority to make a pallet load and concurrent airlift could reasonably be expected, cargo of a different priority for the same destination was added. In such cases the load was handled in accordance with the precedence of the highest priority cargo on the pallet.

Documentation was accomplished through a numbered pallet sheet which was affixed to each pallet at the point of origin and which identified each shipment or separate piece included in the pallet load.

The desired shape of the loaded pallet was approximately 48 to 60 inches laterally, with a height ranging from 60 to 65 inches. The maximum height was dictated by the size of the cargo door of the aircraft to be loaded.

The loads were stabilized with 5/8" metal strapping. The banding was accomplished using standard hand and semi-automatic stretchers and sealers.

Within the aircraft, handling was effected with hand pallet trucks.

For the purpose of the test, no change was made in current manifesting requirements, although it was realized that documentation could be reduced by accounting for each pallet rather than each item. No cargo was removed from the original pallet enroute. The pallets were disassembled at the MATS destination station for final delivery to the consignee, but remained intact through all other processing.

We learned a lot from this test, in fact, we liked the results enough to continue on with the principle and are doing it now and will continue to improve upon it in the future.

Here are some of the results: We found that the average number of individual pieces consolidated on a pallet ranged from 20 to 30.

Palletizing extends the time required for processing to a certain extent. However, this additional time does not impose a hardship. Processing is usually free of pressure created by a requirement to meet specific time deadlines such

as are encountered in loading aircraft. Further, palletizing tends to spread the workload more evenly, smoothing out the peaks and valleys of this phase of the operations. From the processing area onward time and manpower are saved.

Although documentation was not reduced during the test, the findings revealed that manifesting by pallet load, rather than each individual shipment is completely practical without sacrificing control of traffic.

Of prime interest were the findings on the time it took to load and unload aircraft. This has always been a major bottle neck in our handling system. It was found here that the degree of time-saving in loading and unloading is directly related to the amount of the cargo that was on pallets. If one-third of the full load was on pallets, the loading time could be reduced by 25%. If 95% of the load was on pallets, then the time could be reduced by 50%. This saving is further complemented as one-third less personnel were required to perform the operation. A specific example of time saved in loading follows: With a loading crew of one fork lift operator and four men inside the aircraft, 16,600 pounds of palletized cargo, and 3,400 pounds of bulk mail, were loaded on an aircraft in just 27 minutes, as compared to the average of 1 and 1/2 hours. It took only eight minutes to get the palletized cargo in place and ready for tie-down.

The operation pointed out that there is a necessity to exercise close study of cargo schedules with the view to developing entire loads of palletized freight wherever possible and consigning large, bulky cargo to the larger type aircraft.

The weight loading achieved on pallet varied throughout the test with different stations. This ranged from 1,000 to 1,960 pounds per pallet. Aircraft load density achievement was better than expected and completely eliminated the anticipated stacking losses. One squadron attained 18.4 pounds per cubic foot, another 15, and a third approximately 13.5. It was found that 50% of all MATS cargo by weight, and 95% of the number of pieces were physically adaptable to pallet shipment.

Tie-down of cargo was facilitated by palletization. Building up cargo loads into large individual units eliminates the requirement for time-consuming, interlacing of tie-down devices to provide restraint for small individual items of cargo. Palletization points up the need for development of a standard net tie-down system since, with an all

palletized load, an aircraft can actually be loaded in less time than is presently required to tie-down the cargo.

It was determined that utilization of space in the aircraft was actually enhanced by the use of pallets. The space splaced by the pallet itself was more than offset by the gains achieved through deliberate and practiced formation of pallet loads. Through careful loading of the pallets with straight sides and flat tops, exceptionally close positioning in the aircraft is possible.

In summary, let me reiterate the advantages gained by the use of pallets:

a. Reduction in the time required to load the aircraft.

b. Reduction in manpower required for loading within a given time.

c. Better utilization of space through deliberate practiced load construction.

d. Less damage to cargo through reduced number of handlings.

e. Reduction in tare weight.

f. Reduced administrative workload through reduction in number of pieces handled individually, and through fewer lost shipments.

As a result of the experience gained in the projects mentioned above, a policy directive has been published which requires AMC to establish a program which will assure the maximum use of pallets and containers by all consignors, to include unitization, whenever possible, at the contractors facility. The objective being to move supplies in unit loads from source to user when possible.

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Consolidation of Cargo for Shipment

Mr. N. F. Behme, Jr.
Chairman, National Classification Board

You have just heard much concerning the general picture of the problems with which the trucking industry is faced -- and the various remedies that have been tried to solve these matters.

The subject matter here is the "Consolidation of Cargo for Shipment." The idea is not new to the motor carrier industry, but the various specific ways of accomplishing such consolidation are ever-changing and for the most part an improvement over existing methods.

With the inauguration of transportation, the consolidation of cargo was seen to be a way of providing a safe, economical and speedy way of handling many types of products. This was especially true of those shippers who had a multitude of various commodities all generally small in character. Such a mixed package created problems of description and rating — thus our Rule 11 was born. This Rule provides that differently rated articles in the same container must be rated at the highest rated and highest minimum weight (in the event of TL) article in the package. Through the years shippers, packagers and finally packaging engineers have been trying various ideas to make these cargo consolidations more practical.

One of the first tried and true methods was the wooden box. This is used to a great extent today by certain shippers. Of course, the fibre box has replaced the wooden box where practical.

Next came the "Hamper." This is a device with a wooden or steel bottom and top, with uprights or frames of steel (some wood) covered by heavy canvas (or an occasional reed covering). This device has more or less fallen by the wayside, although it is used to a considerable extent by some mail order houses for distribution shipment of certain articles — for the most part, clothing.

Then came the Pallets — in a multitude of forms. There are many types of enclosed pallets capable of taking a number of mixed packages totaling in weight as high as 4,000 pounds. These are used by any shipper who has a variety of small articles, or in many cases by shippers whose primary product is small in nature.

In certain fields of shipping we have the lift van. This is sometimes referred to as a shipping van. With respect to shipments of "Household Goods," this container has been the cause of controversy in the matter of interpreting our Classification. The basic reason was the fact that many wooden boxes used in this type of service were and are as large as shipping vans and in several instances even larger.

It was generally conceded that the essential difference between a large wooden box and a shipping van was only in construction, the latter generally being fitted with a door or entrance. After considerable investigation a rule was finally written that placed shipping vans and boxes of certain large dimensions in the same category insofar as Household Goods are concerned.

Lately we have been confronted with an innovation of a container known to the Military as the "Conex Container."

One of the important features of these containers is that, we understand, they are of weatherproof construction — in other words, they are built as weatherproof as the body of a carrier's own vehicle, therefore permitting the carrier to use open top or flat bed vehicles for transportation and releasing more closed equipment for other freight.

I understand that 3 or 4 Conex Containers can be loaded on today's predominant sizes of vehicles. While I believe it is the practice of the Military to load and unload these heavily loaded containers with their own loading equipment, the saving of carriers' waiting time is very obvious when one thinks of the hundreds of packages that would otherwise have to be individually handled.

This, then, leads directly to a matter of transportation, very close to the carrier's heart (and pocketbook) — <u>the lack of necessity for handling</u>. I believe it is not contested that damage during over-the-road transit is neglibible — the real and prevailing cause of damage is handling over platforms. Any operation or form of packaging that eliminates even one process of handling is indeed a welcome one.

Aside from the feature of reduced handling, because of my understanding that commodities shipped in these containers will also be packaged as required for domestic shipment, they should, while in the hands of the motor carriers, transport extremely well, thus further reducing the carrier's liability damage due to shifting or other untoward incident.

We are aware of the current efforts of the Military to cut their transportation costs, largely by reducing their tare weights; and even though the motor carriers are paid on the basis of weight, we must say your efforts are to be commended, because we know as well as you that a great deal of Military material is overpackaged in an almost archaic manner.

Now the foregoing has been favorable toward these containers. Are there any unfavorable characteristics? We think there is at least one. It pertains not to the suitability or serviceability of the articles as containers, but to a matter of freight charges on the empty returned container. Some of you may, but some may not, be aware of the fact that motor carriers are very density-conscious — density to a carrier meaning weight per cubic foot, and to the extent he gets paid on the basis of weight, a matter of vital importance to him. I have figured the density of Conex Containers to be about 4 pounds per cubic foot. Looked at from a loading standpoint, a truckload of 4 is only 5,720 pounds. That's not much weight for a vehicle to haul that is capable of hauling 30,000 pounds or more of good revenue freight. I don't know what the engineering problems would be, but in this day of scientific and mechanical wonders, it wouldn't seem to be an insurmountable problem to devise them so they could be shipped in a knocked down form. Perhaps you Military people have figured that even paying the freight charges on these containers set up is cheaper than the cost of your present tare weight of wooden containers — I don't know, but just wanted to leave the thought with you.

The only other comment I can make is neither favorable nor unfavorable — it is just that their use is posing a problem in the matter of charges on the loaded containers. For years both motor and rail carriers have observed the practice of assessing on packages containing mixed freight the rating applicable to the article in the container that bears the highest rating. Now the Rule that publishes such basis of charging wasn't drawn in the light of such mixed packages or containers as these — it was drawn to cover such mixed packages as would be made by a mail order or a drug house. However, it is the only Rule existing in the Classifications which provides a basis for charging on a mixed package. Because of the favorable characteristics that these containers present from a transportation standpoint, there is now before the National Classification Board of the trucking industry a proposal, filed by the Rate Negotiation Branch of the Office of the Chief of Transportation, to provide a different basis of arriving at charges on the

commodities shipped as well as charges on the container itself. The difficulty presented by the proposal is not so much what is proposed by the Military, but to determine whether such basis should be limited to the Military and not be so revised — as the Board is being requested to do — as to become applicable to all types of mixed packages, such as boxes, crates and palletized shipments. I thought this might be interesting to you and that you might have an idea of why such a proposal is not capable of being decided overnight, but must be thoroughly considered with a far-seeing eye toward future complications and future effects.

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Consolidation of Cargo for Shipment

Mr. W. J. Walsh
Bureau of Supplies and Accounts, Department of the Navy

During World War II the Navy found it economical to unitize cargo as far back to the source of material supply as practical. The lack of covered storage space and limited manpower in those Pacific Ocean areas occupied by Navy forces served to point up that the then conventional method employed for shipments of large volumes of like material was entirely out of focus with the optimum capability at the ports of discharge. The warehouse pallet together with steel strap and protective corner plates were effectively utilized to unitize small packaged items of foodstuffs and housekeeping supplies. Large supplies of such commodities were unitized directly at the end of the packing line and moved to tidewater in unitized form. Naturally less labor was required in unloading at tidewater and greater utilization of transit shed capacity was realized because the unit load permitted mechanical high piling.

Because of the large volume of war impedimenta, which is not susceptible to unitized palletization, shipments of unitized pallet loads did not contribute to any great excess in loss of shipping space in any one vessel. The tween deck spaces and the squares of the lower ship's hold were reserved for palletized unit loads. It should be realized that all U. S. flag shipping was then under government control and the revenue earning of the vessel was not a very important factor. However, with the ships returned to the commercial operators it is now essential that the ocean tariff now be considered in the cost for affreighting like commodities in unitized loads versus the conventional manner. The standard Navy warehouse pallet measures 8 cubic feet. The increase ocean freight charges to ship materials in palletized unit loads represents 1/5 to 3/10's of the applicable ocean tariff rate. For example, if the tariff rate for packaged cereals is $25.00 per measurement ton and we elect to ship the packaged cereal in palletized unit loads, the cost of the ocean transportation for one measurement ton would then increase to $30.00 or $32.50, depending on whether a warehouse or stevedore pallet was utilized.

With the above in mind, the Navy explored the possibility of continuing the unitization of ocean freight without the use of pallets. During 1943 an unusual loss ratio, due to excessive pilferage, developed over one particular route. Approximately 75 cargo containers were constructed at NSD, Seattle and utilized on a recurring basis between Seattle

and Alaska. The use of the containers served to reduce the pilferage. These containers are still in use. With that background the Navy in 1948 decided to develop a steel cargo container on the general design of the commercial cargo container then employed by a few of the steamship lines. By 1949 the Navy actually had steel cargo containers in use and since then has increased holding to approximately 4,800 units. Practically all of the original containers are still in use. The steel cargo container presents many problems as well as advantages. The size of the container is important since there are stowage areas in vessel compartments which prohibit the stowage of unit loads in excess of 6 feet in height.

Presently this problem is not too accute inasmuch as there is ample acceptable space in the average cargo vessel. However, when thinking of containerization in terms of shipload lots some thought must be given to limiting the height of the container. Based on our experience to date, it is the belief that the container height should not exceed 6 feet. The Navy is now using cargo containers having a carrying capacity of 150 cubic feet, 195 cubic feet, 275 cubic feet and 295 cubic feet. The latter size is the same container design used by the Department of the Army. The other three sizes are based on Navy specifications developed by the U. S. Naval Supply Research and Development Facility at Bayonne, New Jersey.

A variety of sizes permits our packing activities greater flexibility in selecting commodities for shipment in containers. For example, the larger container sizes are not suitable for shipments of liquors. When the larger containers are loaded to capacity with dense material the gross weight is frequently beyond the capacity of conventional terminal and shipload handling equipment. Although it is commonly accepted that conventional ship's gear is capable of lifting 5 weight tons, we experience some difficulty in using containers over one of the more prominent trade routes because the particular commercial vessels allocated for lifting our cargo are incapable of hoisting cargo units in excess of 3 weight ton with the conventional ship's booms. Accordingly, it is necessary for the smaller size containers to be used for cargo of average density scheduled for movement over this particular trade route or else rely on the ship's heavy lift gear. When it is necessary to rely on the ship's heavy lift equipment to load and discharge cargo containers, the added time and cost of labor offsets the economic advantages inherent in the use of containers.

There are many obvious savings accruable through the use of reuseable containers for ocean shipments. However, the savings in packing, expeditious handling and checking must be measured against the cost of ocean freight for the return of empty containers to the port of origin. It is not possible at this time to assure that every cargo container shipped overseas will be usefully employed for a return pay load. The Navy's requirements for return cargo is practically nil. Where possible we endeavor to concentrate container utilization between ports having two-way traffic in cargo. This is not too effective since the volume of exports exceeds imports by over 10 to 1. Retrograde cargo seldom has the characteristics which are compatible for containerization. Outside of Fleet Post Office mail and small lots of baggage our overseas activities generate no suitable cargo for return to this country. Accordingly, we are hesitant to expand our holdings until such time as arrangements are made with commercial conference carriers for reduced rates on containers returned empty. At the present time it costs as much to ship an empty container via a commercial vessel as it does a loaded one. Consequently we attempt to return our containers to the port of origin in a government controlled vessel. While there is no real outlay of government funds for the return of the container via a government controlled vessel the procedure sometimes contributes to delay. Frequently, more expeditious commercial service may be available; however, due to the costs the vessel is not employed. Actually we try to keep our containers in a traffic pattern where government controlled vessels are normally employed. When this pattern is maintained we believe the container contributes savings in the overall cost of distribution of certain fragile and pilferable supplies to the overseas bases. We are not prepared to stipulate the gross percentage of savings per ton for any given commodity as it is difficult to calculate the actual cost for many operations in which improvement is noted. For example, we have made several test shipments where $75 in packing materials was saved when containers were used to effect shipments of clothing. The reduction in packaging requirements alone is a big saving. Expeditious handling, checking, increased stevedore production and elimination of loss and damage also contribute to the overall savings. We do feel, however, that the shorter the trade route the greater the opportunity to generate repetitive savings. Accordingly we endeavor to confine container holdings at East Coast activities for shipment to the Caribbean area and containers at West Coast activities for shipment to Hawaiian ports. We find it necessary to occasionally ship containers to Europe and the Far East; however, the prolonged turnaround time detracts from our capability to accrue the maximum savings attainable per container.

Our experience indicates that a family of container sizes rather than just one size will better serve the Navy's requirements. It is further intended to pursue continued research in design improvements. We are especially concerned with an improved locking device. We have noted that the doors provide the greatest problem in maintenance.

We feel that the principle of containerization is sound; however, we realize that much must still be done in the way of realigning ocean tariffs and conversion of vessel compartamentation before large scale utilization of reuseable containers becomes profitable over all trade routes.

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Morning Panel Session

Wednesday, October 12, 1955

A5. Aircraft Industry Packaging
Chairman, Mr. E. P. Troeger
Materials and Processes Engineer
Douglas Aircraft Company

Recent developments in the packaging of aeronautical items.

Aircraft Industry Packaging

Mr. E. P. Troeger
Materials and Processes Engineer, Douglas Aircraft Company

I'd like to welcome you now to the Aircraft Panel of the Joint Military-Industry Packaging and Materials Handling Symposium. Our first topic today is a subject concerned with recent developments in aeronautical packaging. We actually feel today we have reached a new era in aircraft packaging. We have more and more new and delicate type mechanisms. We have new, bulky, lightweight items that are giving us problems. Many of us, for the first time, are in mass production of guided missiles and related type mechanisms. In this era I think it is going to require a new type of approach. Engineering the packaging is going to be the big new approach with us. We will have a talk on that today by Mr. Hatae, who will be with us shortly.

Actually we have reached a point of delicate balance in many of our problems. Which way we should go is really a problem and I think our discussion today may be helpful in that regard. For instance, our prime objective is the defense of our country. In case of conflict we are going to have to have our articles there in good shape when we need them. On the other hand, we need mobility and cargo space, so we have to cut down on tare weight and expensive and bulky packaging.

Another point of balance that may go either way is the question of subcontractor packaging and shipping direct or shipping through the prime contractor. Also, whether the prime contractor should store, package and ship direct to the using activity. As you can realize, quite a few advantages could be achieved by the prime contractors' stocking parts for the military and shipping them as required. Some of these things will be discussed at this meeting.

In the corrosion field we have many new problems with the recent emphasis placed on stress corrosion and fatigue in aircraft design. Surface finishes are critical items in fatigue. This is being brought to our attention by metallurgists. Actually, we're designing parts with particular finishes to prevent fatigue and stress corrosion. We're even relieving residual compressive stresses on the surface of parts to get better fatigue results. Thus the condition of the parts' surface after shipping and its corrosion protection have become extremely important.

The use of electronic instrumentation for mass storage of dehumidified containers such as we have in the missile field, where thousands are stored and perhaps a mass way of measuring humidity in the stored containers is necessary -- another problem.

Today we plan to discuss these new concepts. I hope most of these things come up that I have mentioned. I know there are a number of others that will.

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New Materials and Methods of Interest

Mr. Earl Gustin
Bendix Aviation Corporation

I have what I feel are several interesting topics pertaining to adaptations of material which I'd like to discuss.

I will refer to the usage of these materials which we are using in our own facilities.

The first item of which I will mention is a new pressure sensitive paper tape. The background for originating and developing this tape is a far cry from the packaging field. Its background is this: One of the automobile manufacturers was experiencing difficulty with moisture getting in the car and discoloring or staining the upholstery. Upon determining the source of moisture, the error was solved by the application of an especially treated pressure sensitive paper tape which, after application, excluded all moisture.

We are using this tape in lieu of pressure sensitive cloth tape when sealing slipcover metal containers for small parts. This tape and the former cloth tape have been tested by an independent laboratory and the paper tape was proven to be more satisfactory than the cloth tape.

Incidentally, the use of the new tape results in a savings of 30 percent, as far as material costs are concerned.

It was brought to our attention roughly ten months ago when over-wrapping certain assemblies in which grease was not a factor that neutral paper might be used in lieu of Grade A paper. To be frank, we had quite a time finding out who manufactured it, but we did find one party who would supply us with neutral paper. Our consumption of 40-pound weight neutral paper now exceeds a hundred rolls per month. Incidentally, we reduced our cost of Grade A paper, which was formerly used on these assemblies, by 71 percent or well in excess of a thousand dollars per month.

Example three is a result of cooperation between the services and the contractor. We have for some length of time packed one of our assemblies in an AN-8025 can. Due to the type of dunnage being used it was necessary to purchase this container extended in height one and a half inches. To effect standardization of the container it was suggested by the Navy, the customer, that we review the pack with the ultimate end

being a container standard in height. After some experimentation we developed a dunnage fabricated of another type of material, which enabled us to use a standard drum. The pack was substantially improved and packaging cost reduced, the drum by 11 percent, the dunnage by 28 percent.

Resea

My reason for citing this example is that each of us should review our packaging to determine when using reusable containers, we extend every effort to develop and use a standard size container.

As of last May 15th, Rule 41 of the Uniform Freight Classification permitted the use of reinforced tape. Shortly afterwards we incorporated the use of this tape in our shipping departments and we have been able to increase production through its use on our final lines by 25 percent. In addition, the saving in steel strapping in our plant alone was measured in thousands of pounds per month.

This idea dates back to 1951, at the Cleveland show of the Society of Industrial Packaging and Materials Handling Engineers. It was my pleasure in returning to discuss wooden boxes with one of the senior members of the organization. He had over a period of years developed a packaging program wherein he had eliminated his carpenter shop. This amazed me because we had quite a carpenter shop.

After talking to this gentleman about how he had been able to eliminate his carpenter shop, I came back to our plant and we experimented further with V-board which, incidentally, we were already using and we also experimented with our first wirebounds for shipping aircraft materials.

I could go into detail as to our experience in savings but I will condense the data by citing the following figures. We have been able to reduce our carpenter shop, which was sizeable, by 62 percent; while our box requirements have increased 40 percent. Our consumption of wirebounds today is not less than two cars per month.

In closing, I would like to make the suggestion that each of us survey our packaging operations and analyse our packaging costs. As the factor of direct labor will remain for the main part constant, it behooves economy-conscious organizations to demand the most of the materials being used and to review each avenue to determine whether other possibly lower-priced materials or substitution of materials will not accomplish the same end results and effect economies over our former packaging.

Engineering the Package

Mr. M. T. Hatae
search Engineer, Missile Development Division, North American Aviation, Inc.

In my paper presented yesterday on the "Dynamic Cushion Tester -- Its Application to Package Designs," the optimum cushion factors were described as properties of package cushioning material. This morning I shall present an example of a package design utilizing the cushion factors and the method for the development of the design from the actual part to the final exterior container.

The two algebraic expressions using the optimum cushion factors to select the proper cushion dimensions are:

$$T = \frac{J_D^{opt} h}{G} \qquad A = R_D^{opt} WG$$

where: J_D^{opt} and R_D^{opt} = optimum dynamic cushion factors

T=thickness of cushion material required

h=drop height

G=fragility of item

A=bearing area of cushion material required

W=total suspended weight on cushions

The cushion factors can be determined by use of the dynamic cushion tester. The drop height is specified in military specifications for rough handling tests. The fragility factor can be determined by subjecting the items to shock tests, consultation with design engineers, or through experience gained from similar items. The total suspended weight includes the item weight plus any interior packaging materials utilized. A sample design work sheet used at North American Aviation, Inc. is illustrated in figures 101, 102 and 103.

An actual package design will next be illustrated.

Part Name: Amplifier Assy.
Net Weight: 9.0 lb.
Fragility: 30g
Method: IIB
Drop height: 30 inches.

Part dimensions:
9" x 8" x 6"

The interior package consists of a corrugated cell, desiccant, container, barrier and container. The total suspended weight is 11.8 lbs. and the outside dimension of the interior package is 10" x 9" x 9-1/2".

The available bearing area for the interior package is then:

Top & bottom - $10 \times 9 = 90 \text{ in}^2$

Sides - $10 \times 9\text{-}1/2 = 95 \text{ in}^2$

Ends - $9 \times 9\text{-}1/2 = 85.5 \text{ in}^2$

The optimum cushion factors for the material presently used are:

$$J_D^{opt} = 3.5 \qquad R_D^{opt} = 0.18 \text{ to } 0.22$$

Thus, from equations (1) and (2), we obtain:

$$t = \frac{3.5 \times 30}{30} = 3.5 \text{ inches} \qquad A = 0.18 \times 11.8 \times 30 = 63.7 \text{ in}^2$$

$$= 0.22 \times 11.8 \times 30 = 77.9 \text{ in}^2$$

A standard corner pad with the required cushion dimensions was used for the cushion design as illustrated in figure 104.

This example illustrates one method in the development of a package design utilizing the properties of the materials, thus insuring adequate protection of the item from the hazards of shipping and handling.

Figure 101

PACKAGING WORK SHEET

ITEM NO.__________	DRWG. NO. DX.__________
PART NO.__________	DESIGNER__________
PART NAME__________	APPROVED__________
PART SIZE__________	DRAFTSMAN__________
NET WT.__________	CHECKER__________
CONTRACT_____ MODEL_____	CHARGE__________
CONTAINER__________	DISTRIBUTION__________
I.D.__________	

Figure 102

Cushion Design Work Sheet

Part No.________________ Method_______________

Part Name________________ Designer_______________

Net Wt.________________ Drop Height_______________

Fragility________________

Interior Dunnage:

Wt._____ Sub.Tot._____

Interior Container:__________ I.D._____________

O.D._____________

Sheet Size_______________

Wt._____ Sub.Tot._____

Barrier: I.D.____________________ Area______________

O.D.____________________

Wt._____ Sub.Tot._____

Desiccant:

$$\frac{(\quad)}{90} + 10\,(\quad) =$$

Wt._____ Sub.Tot._____

Intermediate Container:___________ I.D._________________

O.D._________________

Sheet Size_________________

Wt.____________

Total Supported Wt._______

Figure 103

Cushion Design Work Sheet - Cont.

Available Areas:

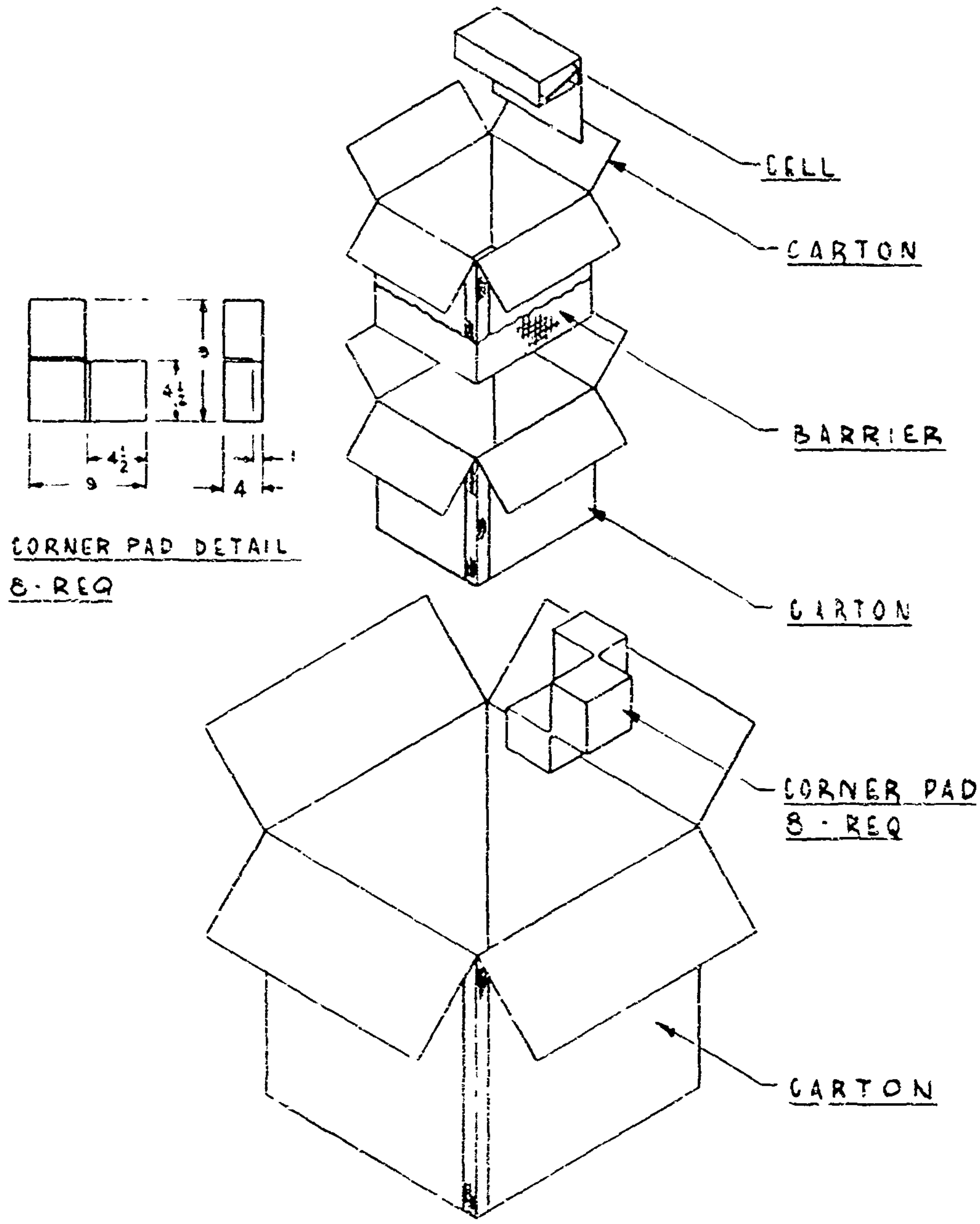
Top and Bottom ______________________

Sides ______________________

Ends ______________________

Cushion Calculations:

Unit Container: I.D. ______________________



SHIPPING CONTAINER ASSY
AMPLIFIER

FIGURE 3[illegible]

Paper-Overlaid Veneer

Mr. Edward Clarke
Forest Products Laboratory

The Laboratory has been extremely interested in the application of paper-overlaid veneers in packaging. We have made several tests and studies to determine its suitability for various uses, such as for the fruit and vegetable container industry, expendable pallets, etc., but the bulk of our work has been in cooperation with the Air Force. It has been aimed at determining the suitability of paper-overlaid veneer as a panel material in fully cleated panel boxes.

We were looking at it as an alternate for container-grade plywood. Our work has been divided into two phases due to the broad scope of the problem. The first phase was to determine its suitability for use in the domestic containers and the second phase was to determine its suitability for overseas use, since it did prove quite suitable in the domestic study.

The work not only involved determination of suitability, but if found suitable, we were to formulate suggested specification requirements. That, incidentally, proved to be quite a task due to the great dissimilarity between commercially available materials. We found many dissimilar characteristics in this product. For example, some manufacturers employ the use of cylinder kraft papers. Others employ Fourdriner Kraft. Some manufacturers use overlays which caliper 16 mils; other manufacturers use paper of 30 mils. Some use dry veneer. Some laminate the paper to green veneer and then dry the completed assembly. Some of them give the veneer a distending treatment for dimensional stability; others do not. Some use white fir or basswood, which are low density species; while others use high density species such as maple and birch. The adhesives also vary. Some manufacturers use a hot press type urea-formaldehyde resin; others use protein adhesives. You can see that if we were to write a procurement specification based on material requirements, it would take quite a thick document to satisfy all the manufacturers. Our approach was to prepare a specification based on performance requirements.

The first study, that concerning domestic suitability, involved the testing of nearly 200 containers and, in addition, we obtained some basic data on this type of material, such as its puncture resistance, water resistance, and static bending values. This type of information required testing over 1,600 specimens of the material.

Now, in most of those material properties, which we were measuring and comparing with container grade plywood, we found that the paper-overlaid veneers were comparable to the plywoods. The plywood we were using was two-cycle material, as used by the military for domestic shipments. The paper-overlaid veneers reacted somewhat differently than plywood in the water-soaking and drying tests. We observed no delamination at the glue line but there was some evidence of delamination in the paper overlay adjacent to the glue line.

Boxes were subjected to the revolving drum and diagonal corner compression tests. In both of these tests, all the paper-overlaid veneers -- and I might add there were 10 or 12 different paper veneer combinations involved -- appeared comparable to the 3/20 container grade plywood. Thus, we prepared a procurement specification based on performance requirements of the material. The property of the panel material which we think most important in completed panel boxes is stiffness. The test data revealed no correlation between rough handling performance of the container and the physical properties of the material except stiffness. That one property did show fairly good correlation and so the procurement specification is based upon the material's stiffness value obtained from static bending tests. There were other requirements such as water resistance and ratio of paper thickness to veneer thickness, but these were kept to a minimum.

About six months ago we embarked on the second phase of the work. This was aimed at determining the suitability of paper-overlaid veneers for overseas use. Since we had amassed considerable information on the physical properties of the various materials, we did not duplicate that work at this time, but we tested another two-hundred containers. Furthermore, we not only used container grade plywood in the containers, but also used V3S solid fiberboard, both of which are acceptable materials by the military for overseas containers.

We were somewhat at a loss to choose a conditioning treatment which might simulate overseas shipping hazards. We knew that plywood has to withstand 10 cycles of 4-hour water submersion followed by 20 hours' drying and that the solid fiberboard must pass a 24-hour water soak test. If paper-overlaid veneers are going to find their way into industry, we thought they should also exhibit certain water resistant properties. Therefore, we soaked them in a tank of water for 24 hours prior to testing.

None of the paper-overlaid veneers gave as high performance as plywood. To me, that is not necessarily an indication that they are not suitable because there are many that believe cleated plywood containers are overdesigned. We also found a marked difference in the performance of the commercially available products in that some containers failed entirely as a result of failure of the panels, while other boxes made from a different manufacturers' product failed as a result of failure of the cleats. There was still a third group of materials which when made into boxes exhibited a combined failure involving both cleat and panel. This is an indication that the container is of more balanced design than either of the other two failure categories.

I think that there is a great future for paper-overlaid veneer materials and I am not unduly alarmed that they did not perform as well as plywood after soaking in water for 24 hours, since some of them performed comparable to the cleated solid fiberboard boxes after 24-hour soaking.

3 of 3

New Developments and Requirements for Specifications to be Used by the Aircraft Industry

Mr. A. F. Calapristi
Bureau of Aeronautics, Department of the Navy

What I am about to cover is general but I believe thorough. Considering the time available I will touch briefly on each subject to stimulate questioning and also to get you thinking, so that you may assist in solving our problems.

To the military all materials and equipment are important, so I will try not to miss any. I will start with humidity indicators of the card type.

For all packages requiring humidity indicators, for the last two years it has been permissible for all Bureau of Aeronautics contracts to use card type indicators interchangeably with silica gel type indicators. However, the use of card indicators has not proven to be satisfactory in all respects. The individual color shades, which have signigied the existent ambient relative humidity readings, were not uniform among all manufacturers. Further difficulties have been experienced with spreading of colors from the confined spots to the surrounding paper cards causing varying breakpoint readings. These discrepancies illustrated the need for controlling these cards more closely, so therfore we initiated a laboratory program to provide for these controls, as I will enumerate:

To obtain maximum time at any specific temperature in which a spot should change from blue to pink for a particular relative humidity and vice versa;

Storage stability of cards concerned, considering the necessity of a dehydrated pack for storage and shipment of such cards;

A procedure for checking conformity of colors between manufacturers;

A way of checking flow of color from the bordered spot to the surrounding paper card.

In developing these color standards or color spots we will try to use recognized color standards, like Munsel or paint chips to match, instead of having a color on the card which will fade with time.

At the present time work has reached a point where specifications are being prepared together with the drawings involved.

Here is an example of what I mean. Here are two indicators (illustrating). I don't know whether you can see them, but you take the two 50 percent readings there, or the two 40's, you will see the color shades are different. This illustrates one of the difficulties encountered.

My next subject will be standardized test procedures. An informal survey was made of the test procedures used by the military to determine the qualities of packaging materials in finished packs. We hoped to reduce the number of specifications which detailed test methods that are generally the same and in which with slight modifications might be one test method.

We divided the first phase into three parts:

(a) To survey existing test procedures by TAPPI, ASTM, Packaging Institute and the military;

(b) To establish a cooperative testing program between laboratories to resolve differences in those test methods which may not be standard; and

(c) To establish a program for the development of entirely new test methods.

The first phase is complete and this document is in the process of printing at the present time. The number of this document is Interim Federal Standard 00101 (Navy-Aer) and the title is Packaging Materials, Packages and Packs; Methods of Inspection and Testing.

The third subject I have here is "Sprayable and Strippable Films." We have been testing, both in the laboratory and service activities, a water emulsion sprayable type film, the objective being to obtain a satisfactory film for the protection of airplanes for overseas shipment and for temporary or indefinite storage outdoors. This film provides protection by a two-coat system. One coat, which is pigmented black, is applied to a thickness of about nine mils and it is overcoated with another pigmented coat of white of approximately three mils.

In March of 1954 we had two airplanes coated with this material. The white is applied over the black coat to protect it. The black coating has virtual inertness to lacquered surfaces, while the white coating serves to decrease the internal temperatures of the enclosed airplane. We have found that when comparing the internal temperature unprotected airplane with the protected airplane, at an average temperature of 98 degrees, there is a difference of 14° F. Inside the unprotected airplane the temperature went to 135° F, while inside the protected one it only climbed to 95°.

Airplanes were coated at the Naval Air Facility in Litchfield Park, Arizona, in March 1954. One of the airplanes had completed a service tour and was awaiting overhaul. The second had been overhauled and painted. An examination of the overhauled and painted airplane after nine months outdoor storage revealed that the plastic film was removed without difficulty; lacquered finishes were in good condition; canopies in flyable condition; fabric surfaces remained unchanged; and in areas sealed by the film dust infiltration had been retarded, if not totally excluded. Visual examination of the bearings revealed adequate protection afforded by tape wrapping and the oversprayed film covering. The rubber bits and pieces oversprayed by the film remained in excellent condition.

By this method of preserving airplanes we expect to save substantial amounts of money.

Water-vapor impervious barriers is my next subject. At the present time there is in circulation throughout the military departments, as well as industry, a proposed specification covering highly water-vapor resistant barrier materials. The number is proposed MIL-B-131C. This revision represents an improved means for evaluating barrier materials, the objective of which is to screen out the better materials and thus assure superior products for protection of military items. This revision contains a reworking of the accelerated aging tests by varying the length and type of cycle bearing upon the specific requirement being evaluated, such as lamination of plies, seam strength and water-vapor transmission rate. It also contains a modified impact requirement for the Class 2 materials in the specification, simulating actual conditions more closely, and also to test the oil resistant properties of the barrier material by their aniline point and viscosity at a definite temperature, which is a truer indication of the ingredients in an oil, such as percentage of type of aromatics and naphthenes compared to base stock.

This isn't fully coordinated. We're still awaiting some comments and as soon as we get these we will take steps to promulgate the specification.

The next subject I have is water-vapor resistant flexible envelopes. We have also placed this specification in circulation and this particular spec covers envelopes of a complex nature, more complex than those that would be procured under MIL-C-6056A(ASG) or JAN-P-117. The number of this specification is MIL-E-6060A, superseding MIL-E-6060 which was primarily concerned with envelopes for the packaging of aircraft engines. However, in this revision we extended it to cover envelopes used for larger equipment such as compressors, pump assemblies, machine tools and the like.

There are requirements in this specification to cover windows or attachment of gaskets to the envelope and also for testing double seams used in making an envelope which is greater in size than the base width of material.

Another point of interest in this specification is the elimination of qualification tests. We felt that by controlling the acceptance test more objectively and pinpointing the inspection tests, we could eliminate the need for qualification testing.

The next topic I have is preservation and packaging of anti-friction bearings, associated parts and subassemblies.

In order to keep abreast of all technological advances and clarify those parts subject to interpretation, we have included additional options in Specification MIL-P-197. One of the new containers is a multiple compartment package be constructed of an oil-resistant, transparent plastic of proper thickness to protect the bearings and maintain needed rigidity. Each compartment is to be sealed individually so as to be leak-proof and form an integral unit which may be detached from the composite group without affecting the protective integrity of the remaining bearings in any way. Each compartment must be constructed so that the contained bearing will be fully immersed in oil under all storage positions.

We are also including in the specification another type of container. That is a spirally wound fiberboard laminated cylindrical container with metal ends. The specification on these containers is MIL-C-3955.

When planning and engineering a package employing this container, the designer should be assured that the bearings and overwrap will be securely positioned within the tube. If additional dunnage is required to prevent movement of the bearings, appropriate thickness of the intimate wrapping materials should be used.

My next topic is Military Specification MIL-P-3420 for volatile corrosion inhibitors. We are making an attempt to put this specification on a full performance basis. The present requirements are interpreted to require a two gram per square foot loading of VCI chemical on the carrier. Since corrosion protection is accomplished through volatilization of the active ingredients of the chemical, a more positive requirement would be to determine the vapor's ability to protect a metallic article in a corrosive atmosphere.

Following this thought, the Naval Air Experimental Station in Philadelphia developed a test which would not only determine the ability of the vapor to inhibit corrosion but also, through a process of vapor depletion, anticipate the approximate effective service life of the material. By substituting these test requirements, it is intended to eliminate the necessity for the weight of loading requirement. This latest procedure, termed the Vapor Inhibitor Ability Test, has been forwarded to the material manufacturers for their approval or comment. Upon receipt of all replies, further action will be taken.

We have made a recent survey of major Marine Corps and other naval activities, to find out the use status of VCI.

This survey indicates that few aeronautical items are processed with VCI materials but where they have been used, the results compare very favorably with conventional means. The reluctance to use VCI materials on aeronautical materials appears to stem from two factors. One is the nature of aircraft equipment; the other is the fact that the use of VCI in accordance with military requirements appears to be just as expensive, if not more expensive than conventional means.

All of our electronic and electrical equipment on which oils, contact preservatives or VCI vapors would be harmful, and those requiring a vaporproof barrier are being packaged by Method 2. Our non-metallic materials, such as live rubber, cork, leather, plastics, oxygen equipment on which oils and possibly VCI vapors would likewise be harmful, are being preserved by Method 3, la or lc as required.

On the other hand, satisfactory results have been experienced in using VCI materials for protecting spark plugs and 50 caliber and 20 millimeter guns. VCI crystals have proven to be of advantagé in preserving the portion of the cylinder bore above the piston head in assembled aircraft engines. We have had high success in that.

In one air station, VCI papers proved of advantage in solving a shop problem by preventing brake discs from rusting while awaiting installation. In this particular case, these brake discs corroded while awaiting installation. By covering them with a layer of VCI we solved that difficulty.

The Naval Air Experimental Station, Philadelphia, is working to further the potential uses of VCI. They are investigating the need for use of cleaners and neutralizers, and auxiliary oils or preservative compounds in conjunction with VCI and also the effects of surface finishes on accomplishing VCI protection.

The next topic is preparation for delivery of aeronautical parts and equipment. At the Aircraft Industries Association Western Regional District meeting in June of this year at Seattle, advance copies of a revision to MIL-P-7936 were distributed to the staff members and the presiding chairman. This specification included an appreciable number of recommendations from previously submitted AIA comments. However, in the process of converting this specification to full military use it appeared to be in the best interests of the government and all concerned to make certain modifications.

There are four major changes. One is the inclusion of drop tests for cylindrical containers. The second is elimination of the high frequency vibration range which is considered to have fulfilled its usefulness. We also defined the relationship of MIL-P-116 to that of MIL-P-7936, as far as rough handling tests are concerned. We don't plan to use rough handling tests, but if we do use them are going to require those of MIL-P-7936. We added an additional test which will only be applicable to containers supplied with a shock mount suspension system. We're going to require a 24-inch flat drop on these containers. By this method we will be taxing the suspension system to the utmost.

My last topic is pressure sensitive adhesive tape for packaging and sealing. After considerable laboratory investigation in conjunction with service experience, Specification PPP-T-0060 was issued as an interim specification.

This particular specification will eventually supersede JAN-P-127. The basis for issuing this specification was to obtain better grades of tape, that is, to select those superior grades that have been giving us satisfactory performance and to keep abreast of advances in the tape industry.

We appreciate the cooperation of industry in assisting our laboratory people in developing the requirements in the specification.

I have covered significant parts of these various topics to stimulate questioning. Don't be afraid to ask questions at the proper time, because we have in the audience personnel from our Overhaul and Repair stations, laboratories and procuring activities. We have them from ASO, NAMC and also from other factions of the Bureau of Aeronautics, and each one can contribute to any type of question they may have.

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The AIA Preservation and Packaging Program

Mr. David Nunn
Lockheed Aircraft

Packaging, as I am sure that you all know, is a very unique field and, to say the least, a most interesting field. We have been treated to a great deal of information that I am sure is going to be helpful for us in the days to come.

To give you an idea of what packaging means to some of us or, at least, some of the youth in the business, not long ago I asked a young man who had spent only about six months in an administrative spot in a packaging firm how he liked the packaging business. He expressed his interest this way; he said, "Dave, I don't want you to think that I am queer for packaging but to me packaging is a lot like sex. There may be some things better and there may be some things worse, but, believe me, there is nothing quite like it."

Not only is packaging a unique field but, with respect to freedom of creative expression, I'm inclined to suggest that packaging competes with the recognized artistic endeavors of writing, composing and painting. It is a business that is literally crowded with creative problems and they, fortunately, to stimulate our interests, are usually the kind of problems that defy a single right answer. I think that there are sometimes many solutions to the problems. I think it is pertinent to note that none of us in the packaging field have a corner on the "know-how" of solving all of our problems. I hope you will agree with that statement. I believe you will.

First, as a warm-up to the subject, I want to play a little background music to set the stage for information on the AIA preservation and packaging program.

This business of having the "know-how" spread out, so to speak, suggests that among industry, and between industry and the military, TEAMWORK is definitely a must. TEAMWORK, to get this know-how in the same corner, so we can more effectively and efficiently resolve our packaging problems. I think this is particularly true in the area where the eye appeal-buy appeal phase of packaging is not of primary concern. I am sure there are many gentlemen present who are interested in things other than aircraft packaging per se. I mean you are interested in the merchandising type of packaging, but, generally speaking, our industry, that is the aircraft industry, is not involved with the type of merchandising that attracts its customers through artistic package

design or eye appeal. Our products, of course, are not sold on the basis of our packaging or shipping room accomplishments. I am sure you all know that our profit potential in the aircraft industry does not depend, as a rule, on the merits of our packaging accomplishments or packaging program.

In this business we don't have many, if any, packaging secrets. Our doors usually are open and we freely exchange packaging ideas. I think you will agree again that this is good and that such an atmosphere induces the cooperative exchange of helpful packaging information. In such a healthy climate we can and do discuss, as I have indicated, packaging developments and the techniques and materials that go into our various packaging programs. Of course, we can and do freely discuss (and also quietly cuss occasionally) certain duplicating and sometimes conflicting military directives and/or specifications. Ostensibly such specifications were issued or released to obtain or realize a constant level of product or container performance, but I think that you know that collectively these difficulties sometimes move to retard the greatest monetary and efficiency gains that might otherwise be realized.

The preceding comments were offered to simply scratch the surface, to justify or excuse the existence of the Aircraft Industry Association's Preservation and Packaging Committee.

A few days ago on the coast I had occasion to hear a man rather bitterly explain that he had a good definition of a "committee." I am not certain -- he might have been joking when he made his definition, and he was referring, by the way, to any committee. He went on to define that in his estimation a committee is a group of the unfit, named by the unwilling, to do the unnecessary.

Well, possibly there was something in his experience, in his mind, that justified such a definition. I am going to suggest that if he was serious he was surely a cynic. Regardless, speaking for the AIA Preservation and Packaging Committee, I have to take firm exception to his definition. In the first place, management now demonstrates a very keen interest in its packaging programs. I am not telling you gentlemen anything you are not well acquainted with. You know World War II focused attention on the need for and desirability of improved packaging and since then it has been a willing management -- both management in industry and management in the military -- have recognized and emphasized the importance of packaging.

Management in these two groups has given recognition and emphasis to packaging not only as a tool for progressive product merchandising, but also they have emphasized it as a means of assuring field support to that more important production unit of the aircraft industry. I refer to field support for the delivered airplane or weapons system.

Now, secondly, the so-called "unfit" members that comprise the Preservation and Packaging Committee consist mainly of top level, high quality people, that is, administrators, engineers, specialists, technicians, men who are responsible for the direction of, or who are directly involved in, the preservation and packaging functions of their respective companies. You have received an indication this morning already of the type of men that are involved in the preservation and packaging functions of the aircraft industry.

As to the necessary and productive purpose in our existence, I would like you to take a look at the objectives of the committee. The basic objective of the Preservation and Packaging Committee is to provide an authoritative source for the industry's opinion on problems affecting the preservation and packaging of aeronautical equipment.

Another objective is to serve as a channel through which the military services, or government agencies, as well as other member companies, can obtain or exchange valuable information as to preservation and packaging. One of our aims is to promote and effect cooperation and coordination among the various packaging agencies of the services and industry.

The scope of the activity of the committee covers all phases of preservation and packaging of the type of parts, materials or equipment that is manufactured or used by the aircraft industry. I should add that each committee member has a very keen responsibility to serve as coordinating agent within his own company among such agencies as engineering, inspection, spares, traffic, finance -- and I am sure there are several others that I don't bring to mind at the moment.

When we say that the basic objective of the committee is to provide authoritative source for the industry opinion on problems affecting preservation and packaging of aeronautical equipment, we're in effect saying that that opinion is based on full coordination within the aircraft industry. Since the establishment of a formal AIA Preservation and Packaging Committee, the military has already had occasion

to use the committee to obtain expressions of industry opinion. I would like to suggest that I see encouraging signs that this practice not only will be continued but it will be continued on an increasing scale.

I believe this symposium is one of the indications in this direction. This, of course, is not only desirable; I think that it is most necessary. The Committee has long endeavored to promote this increased coordination or military-industry preservation and packaging relationship; and we will continue to do this, because of the belief that it is in the mutual interest that material should be adequately prepared for shipment and storage, at the lowest possible cost, with the least possible effort, with maximum ease and orderliness in interpreting and administering requirements, and with due consideration being given to logistics and basic packaging and transportation economics.

We believe that whenever cooperative endeavor or uniformity of procedures or specifications contributes to greater efficiency, the door for coordination is open and should be promptly entered. The door for coordination swings open and industry and the military should, of course, enter that door and I believe we have seen, as I have already indicated, signs that we will do just that.

The preservation and packaging committee of AIA holds that in the interest of standardization it is desirable both for the military services and for industry to collaborate and work to the end that specifications with overlapping requirements will be removed. This, I think, is a herculean challenge but I think it can be accomplished. The committee holds, and works to the end, that when an existing specification -- one that was originally released as a truly MIL document, a joint military service or multi-service document -- when such a spec needs improvement, the improvement should be accomplished by clarification of the existing requirements and the clarification should be by changes or additions or deletions, but, not by writing a new overlapping single-service document.

I'd like to give you a fleeting picture of the business having both military and industry interests, and which is now before the committee. To do this I will hurriedly name the subjects that are carried on the committee agenda as active items or at least the most significant ones. Tony Calapristi has already called out the one I had on the top of the list, and they are not necessarily in order of their importance to either the military or industry:

Specification MIL-P-7936: This is a BUAER document entitled "Preparation for Delivery of Aeronautical Equipment." We feel that this document has received real serious coordination effort by both the AIA Preservation and Packaging Committee and the Bureau of Aeronautics.

Specification MIL-P-116: This is entitled "Preservation Methods"; and, as a part of this subject, we include the table of permissible procedures that was recommended by industry for inclusion in MIL-P-116, Revision C. I trust, along with my colleagues, that it makes it.

Specification MIL-P-6200: This is a USAF proposal and covers preservation, packaging and packing, I believe, limitations for.

Military Standard 129A, covering marking for shipment and storage.

Specification JAN-P-108, applicable to Fiberboard Containers for Overseas Shipment.

Department of Defense Directive No. 4100.14, dated July 20, 1955, a fairly new release. This outlines the DOD policy for uniform preservation, packaging, packing and marking of items of military supply.

Specification PPP-B-601, for both domestic and overseas plywood boxes.

And the last I have listed here is Military Lumber Requirements of Current Container Specifications.

That, gentlemen, in a nutshell, completes the review of the Preservation and Packaging Program of the Aircraft Industries Association. It is an ambitious program but one which is workable and, we think, an undertaking that is certainly worthwhile both for the military and for industry.

Mr. Gustin indicated earlier in his discussion that this is a business that requires constant attention to further our economies and it occurred to me, as he made the comment, that the firm I worked with prior to my Lockheed safari had a creed along that line: We know that we're never through with the packaging job, that no matter what the design of the pack that we come up with, the guy that follows us is going to find a better one.

Thank you very much, gentlemen, for your very wonderful attention.

DISCUSSION

MR. TROEGER (Douglas Aircraft Company): I'd like to open this to general discussion and you may address the Chair, stating your name and affiliation, and address your question to any one of these gentlemen; or, if there are some questions you feel can be answered out of the audience, this is also feasible.

Would someone like to initiate this, please?

MR. GALLAGHER (NAS, Alameda): We have a problem on reusable containers, prefabricated dunnage; once it gets into the activity and is used and not used again for some time, it loses its identification. If the dunnage can be numbered or classified so that it will go back into that dunnage it would be a great help because once it gets out into the field it loses all trace and never goes back in again. If that could be straightened out some way it would help out on the stations an awful lot.

MR. TROEGER: Is there someone in the audience here or on the panel working on identification of dunnage?

MR. GUSTIN (Bendix Aviation): I might state that the Navy has already assigned stocklist numbers to cans and dunnage.

MR. NOBEL (ASO, Philadelphia): We are stock-numbering the cans plus the dunnage, so that they will be easy to identify. Tomorrow we will talk more about that at the BUAER meeting. I have five examples of what we are going to do.

MR. TROEGER: What type of identification do you put on the dunnage?

MR. NOBEL: What we do is decide that this can, plus dunnage, is so peculiar we assign a stock number to its assembly, the can assembly, and it is described as can plus the dunnage. We have a series of instructions we started out on in conjunction with BUAER two years ago and that program is beginning to grow and will cover the problem you mentioned.

MR. TROEGER: Any other comment on that question?

MR. MUSTIN (Container Laboratories): My question is addressed to Mr. Clarke. Unless I missed it, he didn't tell

us how the paper-overlaid veneer containers performed in comparison with the V3S containers. Could you give us the · · sult on the V3S?

MR. CLARKE (Forest Products Laboratory): Comparable.

MR. MUSTIN: How?

MR. CLARKE: Some of the paper-overlaid veneers were comparable in rough handling to the V3S material after 24-hour water soak. The paper-overlaid veneer boxes withstood higher diagonal compression loads.

MR. MUSTIN: Would you, as a brief summary, say as good or better than V3S?

MR. CLARKE: As good as.

MR. WOLFORD (Koppers Company): I'd like to ask Mr. Clarke, in view of your findings on this paper replacement for plywood, it appears to me that what is needed is more of a moisture barrier either for surface or edge. Does edge moisture absorption seem to be the principal difficulty or the surface?

MR. CLARKE: Well, any delamination evident in the overlays is located on the edge of the specimen just as it would be on the plywood or solid fiberboard specimens. I don't know of any practical way to overcome that. The manufacturer produces a large sheet and that sheet is cut up into smaller panel sizes, exposing untreated edges even if the larger sheet had had the edges treated.

As I mentioned, most of the adhesives used do withstand cycle treatment but the delamination, if it occurs, is within the overlay adjacent to the glue line. One way to eliminate this difficulty might be by using a resin-impregnated overlay, but you'd probably have to go in the neighborhood of at least ten percent resin content which would eliminate the price advantage of paper-overlaid over plywood.

MR. WOLFORD: I had in mind -- it appeared to me from your description that a moisture barrier was much needed and it looks to me as though these half mil or more, if you want polyethylene layers -- I mean coated papers -- either one or multiplies, might raise that moisture barrier very extensively and quite cheaply and at the same time that polyethylene may serve, in adequate thickness, as adhesive.

MR. CLARKE: I hope most of you understand that paper-overlay veneers employ the use of low grade cores. It is pretty obvious, if the manufacturer were producing veneer to meet plywood standards he would make plywood, since it is more profitable. The paper-overlaid veneers provide an outlet for the lower grade veneer and, consequently, considering the core, adhesive and paper-overlay, the overlay appears now to be the most expensive component; so any time we alter that we raise havoc with the initial cost.

MR. TROEGER: A question in the back?

MR. GALASKA (Pratt Whitney Aircraft): I'd like to direct the question to Tony Calapristi.

Has there been any development, investigations or tests in ultrasonic cleaning of multi-roller bearings as far as BUAER is concerned or in the field, or has ultrasonic cleaning been investigated by any bearing manufacturers?

MR. CALAPRISTI (BUAER): I don't know whether it has been investigated by manufacturers. However, that is something that is just a little out of our field as far as packaging is concerned. It has been investigated by the Bureau, I am sure.

MR. TROEGER: Any other comment?

MR. ALTENBURG (Diamond Match Company): A small company in Maplewood, Maine, has done a great deal of experimentation in ultrasonic cleaning of bearings. The manufacturers of bearings have testing equipment and have also experimented with ultrasonic cleaning of bearings. If the gentleman will see me afterwards I will talk to him on that. It is the Baker Company of Maplewood, Maine.

MR. TROEGER: Questions?

MR. CONNOLLY (Cadillac Products): On the vacuum packaging, is that still in a talking form or are there actual contracts where it has been accepted as an acceptable packaging method?

MR. CALAPRISTI: Are you talking about the vacuum plastic for bearings? Well, it is past the talking stage and a rough draft of the specification has been prepared to include that type of packaging. Now, as to whether it has already been procured -- that is, bearings procured utilizing that particular method -- I really don't know. We don't have any indications of it in the bureau anyhow.

MR. MUSTIN: Do I understand that is limited to only bearings so far?

MR. CALAPRISTI: Well, it is going to be in the bearing packaging specification. Therefore, in utilizing that specification it will be limited to bearings. However, there is a study going on at the present time for larger type of bearings, utilizing other kinds of plastics, and we can see the possibilities of protecting other equipment that is adaptable to this type of preservation and packaging. It doesn't have to be on bearings.

MR. MUSTIN: The present requirement in the 8574 forbids the use of VCI on any assembly that contains cadmium plate. To start the argument, my question is: If that restriction remains the same, how is the aircraft industry ever going to be able to use VCI on an assembly?

MR. TROEGER: I agree. It eliminates practically everything.

MR. CALAPRISTI: Well, that is true, Gordon. That is one of the drawbacks. We have to get more practical tests. I have found out at this symposium that in full field use VCI appears to mottle the surface of cad-plate. However, it appears to retain its protective properties. I believe Phil Gelbar can tell you about tests run at NAES, in which VCI materials were placed in contact with various metals, cadmium, zinc, aluminum, and so forth. They tried out all of the VCI materials in existence at certain temperatures and humidities for a certain length of time and compared each one. In those investigations it did affect cadmium.

I pointed out I heard something about service tests, whereby VCI has a slight effect but in all probability will not affect the operating properties of that part in the equipment involved, so we will look more into that.

Can you add something to that as far as cad-plate and VCI?

MR. GELBAR (Naval Air Experimental Station, Philadelphia): I don't want to take the dubious responsibility of being father of that requirement. As far as the effect on cadmium plate, I think Gordon is right in that it is a surface effect. In writing 8574 we took the position of being ultraconservative initially with the thought in mind of reducing the restrictions as materials get into use more and more. One thing we're concerned with, as far as cad-plate and VCI goes,

is how are we going to educate the inspectors to recognize detrimental staining, if you will, as compared to nondetrimental staining and that has been one of the things that has slowed us down. You tell them once, "Well, if that blackens, it is no good." Then the next time if it blackens it is good. They are going to be somewhat confused. I don't know how we are going to solve that problem. We're open to suggestions.

MR. MUSTIN: I told my client not to pay attention to the requirement on simple attaching parts such as nuts, bolts, screws, washers, etc., and that sold him for all practical purposes.

MR. TROEGER: Question, Joe?

MR. NOBEL: The engine companies, part of the aircraft industries -- we have already gone to utilizing VCI requirements in that area. All spark plugs, for example, provide VCI boys with selling jobs. So far they have come back and said they never heard of any difficulties. We do include VCI now in the production contract.

MR. TROEGER: Questions?

MR. FRENCH: As far as cad-plate and also magnesium under accelerated laboratory tests, we find it does have very distinct detrimental effect. However, under the vapor phase and field testing that does not occur. We can't see where it does any harm at all to cadmium, does not even stain it; so I think, in testing the packaging of cadmium plating and magnesium, the parts would meet VCI tests, except, we will say, at relative humidities of 85 to 90 percent, where you are going to get in trouble but I think you will probably get the same problem whether the VCI was in pack or not.

MR. TROEGER: Is there a question on something besides VCI now.

MR. LOVELL (NAS Alameda): I'd like to address a question to Mr. Calapristi on this subject: On this bearing pack you had here, has any test been run to determine whether or not that is a watertight pack? Is it actually supposed to be a sealed pack.

MR. CALAPRISTI: It is sealed at both ends. We have evidence from a report which was conducted in cooperation with Army Ordnance that these metal end, spiral wound,

fiberboard compressed mounted board cans will pass all the tests of MIL-P-116.

MR. LOVELL: Just looking at it, it seems quality control will be very difficult in a setup similar to our O and R departments where you have varied help.

MR. CALAPRISTI: You mean to use that at the O and R shops, is that what you are talking about?

MR. LOVELL: Yes.

MR. CALAPRISTI: We don't know if it is the intent or not on account of the equipment that will be involved, but I believe if there are enough bearings involved that is something to consider.

MR. LOVELL: The reason I am saying that, if it is in the specification, the first thing production will hit us with is: Can we do it and how? That was the only thing.

MR. CALAPRISTI: I just received a note here from Gordon Mustin. Since Gordon Mustin left the Bureau of Aeronautics he has been getting around quite a bit and he states that it is already in an Army installation. So what I can do with that is check the Army and find out where it is. Will you give me your name and I can arrange it so the two of you can get together sometime?

MR. LOVELL: Are you going to be in BUAER tomorrow?

MR. CALAPRISTI: Sure.

MR. WRIGHT (North American Aviation): I'd like to address a question to Mr. Calapristi on Spraylat covering of airplanes, the two-coating system. Did you find that on the covering of the canopy or windshield and did you have to plan any problem in removing the Spraylat after it had been on there for some time?

MR. CALAPRISTI: I think I can answer your second question very readily. There wasn't any difficulty in removing the Spraylat material.

Now, I wasn't at the stripping operation of the particular airplane when it was stripped after nine months. However, we do have another member of the Bureau of Aeronautics that was there and I believe he can give you the answers.

MR. JOHNSTON (BUAER): In connection with the aircraft that was stripped out at Litchfield Park in Arizona, we examined the aircraft pretty carefully and we could note no obvious deterioration of the canopy structure. It had been there only nine months, but I understand another one is going to be stripped out and we will know a little more about it at that time. After nine months of desert storage at Litchfield Park there was no noticeable deterioration.

MR. GALLAGHER (NAS, Alameda): We're running some tests at Alameda on a similar problem. We have seen no crazing of plastics at all. The coating seems to be holding up well; does not have good bridging characteristics. We have had to do some checking on seams. The coating itself seems to be holding up quite well. We will have a complete report for you on that later.

MR. DECOT (Craig Systems, Danvers, Mass.): Mr. Hatae, I was wondering, to make your explanation of an engineered package complete, I wonder if you conducted any tests on various types of materials to determine the JD-opt and RD-opt. Do you have particular types of figures?

MR. HATAE: We are just in the process of utilizing the dynamic cushion tester to determine the optimum cushion factors and so no values are presently available.

MR. DECOT: Thank you.

MR. TROEGER: One question I would like to enter here: This has been asked me out on the coast. Some of the manufacturers on the West Coast are very much interested in mass production of dehumidified missiles where lengthy storage is involved. I understand that the Signal Corps had a test program on evaluation of electrical humidity indicators. Does anyone know the status of that program or as to whether it has worked out satisfactorily? It would be a big advantage if we could get some information on that. It is pretty hard to get.

MR. CALAPRISTI: You talk in that connection about the missile itself or are you talking about the humidity indicator?

MR. TROEGER: In other words, you might have two or three thousand missiles in storage and would like to know or record the humidity of each missile at a particular time.

MR. CALAPRISTI: There has been a committee set up to evaluate all electrical sensing devices to come out with a standard unit. The Signal Corps undertook the project to evaluate various indicators. The project is now about a year old and I believe they have come to the conclusion since these indicators all work differently and it is pretty tough to formulate requirements because they are different, the electrical systems are different -- some are worked in AC circuits; others have DC circuits; and it is a little too complicated to set up requirements, so there are two phases there. One was to see if the government could develop a system and the second was to get one from the manufacturer that would cover the wide range we're looking for, because the ones we have today, especially some manufacturers, only go from small range and are not temperature compensated. Others have temperature compensators built in these. So the Signal Corps is to come up with an indicator which will do the job. As far as exact results, I think that is still pending but we expect to get the Signal Corps report early next year.

MR. MYERS (NOP, Indianapolis): We just started using some of these humidity indicators. It is true they are just for a certain range, I think 20 to 45 relative humidity, but you can make a cluster and have a very wide range if you want to. We have a package up on the roof of the plant, sitting up there all summer long and it hasn't changed a bit. We plug it in and check the humidity and it is below what we can read right now. Our lowest estimate is 20 and it goes below that and it doesn't faze it. We use a control package to check and apparently it is satisfactory. We hope within another year we will have something on that too.

MR. CALAPRISTI: However, we do have another project we're working on ourselves, to evaluate economically all the types of humidity indicators in existence.

We have a man here that is very close to that job. In fact, he is project leader on that particular job. He might have some information for us.

MR. RUDD (NAS, San Diego): We're using these indicators from a practical standpoint in field application to see where they would fit into our program and into the Navy packaging program at the air station level. We have had a series of applications in storage for approximately eight months to try to make some sort of a time study under production, against a production situation, in which we evaluate the time necessary to install the various equipments.

I can see where accurate determination might warrant the expenditure necessary in using electrical sensing units. The only trouble we found with those we have tested is this narrowing; you very seldom find a package that gives you a reading. It is still a flowing situation, either above the scale or below the scale. It is awfully darn hard to catch a package in that scale so you have again gained nothing, so at the present time from our packaging program we see very few applications where the expense of an electrical sensing indicator with the narrow range now available is justified.

Now, in a guided missile setup or atomic energy setup, where critical control is involved, I think there is a place for the electrical sensing devices.

For the moment that is all I have to report but we are getting out a report in the next few months showing practical field applications, not laboratory tests. I think there are a lot of people that have run laboratory tests, including a series of tests at Philadelphia, and we have made no attempt to duplicate those things.

MR. TROEGER: Gentlemen, I think we all owe a vote of thanks to our panel members and should give them a round of applause.

The meeting was adjourned at 12 Noon.

Morning Panel Session

Wednesday, October 12, 1955

Mr. H. E. Rodenbaugh, Jr.
Head, Preservation and Packaging Branch

"Dynamic Dehumidification" as known to the Navy, was once the target of a syndicated Washington columnist who ridiculed the term as just so much Navy "gobbledygook." Nevertheless, the ideas of a farsighted officer, Captain H. Gordon Donald, USN, literally saved the Navy as an effective fighting force after World War II and saved the US taxpayers untold millions of dollars through this simple method of preservation applied to ships of the inactive Reserve Fleet. Some 2200 ships from our World War II fleet were kept in as good a condition as they were the day they were sealed up, with even the "obsolete" vessels pressed into rapid service when the Korean fighting began. I believe we all know the story of the mothball fleet but comparatively few are aware of Dynamic Dehumidification as applied to warehouse storage as a medium of material preservation or as supplemental protection to packaged supplies, material and equipment.

In operating the Navy Supply System, the Bureau of Supplies and Accounts supervises the procurement, receipt, custody, warehousing, and issuance of all Navy supplies exclusive of ammunition, its components, other explosive devices, and pyrotechnics. For the prevention of deterioration to these countless items it relies upon conventional preservative packaging, upon Dehumidified storage or combinations of both.

Our first work in the area of dehumidified storage drew upon the experimentation of the Bureau of Ships with its Humidity Test Chambers at the Philadelphia Naval Shipyard. The experience with the Test Chambers indicated the choice of 40 per cent daily average relative humidity for warehouse operation.

At the Philadelphia station, five steel containers 15 feet x 20 feet x 12 feet were constructed of steelplate in an outdoor location. These were filled with representative materials. Dehumidification and humidification equipment were installed to maintain these cubicles continuously at relative humidities of 15, 30, 45, 65 and 90 per cent while allowing the temperature to swing with the weather. Materials in the 15, 30 and 45 per cent relative humidity containers were in completely serviceable condition after more than three years of test. Some slight evidence of deterioration was found in the 45 per cent chamber - but this was laid to the fact that it was impossible for the machinery to keep pace with temperature changes at all times, and there was some inevitable

lag loop action, which threw the relative humidity to higher levels. The small size of these containers also allowed radiation cooling of materials to induce high local relative humidities.

Summing up all the evidence available at that time, it was conceded that higher relative humidities could be safely carried in a warehouse than in the small containers used in the basic test. The tremendous ratio of warehouse heat storage capacity to solar heat adsorption surface eliminates the lag loop characteristics inherent in small containers. Thus, the choice of 40 per cent daily average relative humidity for warehouse operation was made.

In further confirmation of our requirements in 1946, 75 hygrothermographs were placed in our four inland supply depots - namely, Mechanicsburg, Pa., Scotia, N. Y., Clearfield, Utah, and Spokane, Washington. With these installations we collected data on temperature and humidity experienced in warehouses. The resulting data were used to serve as a basis for final resolutions of problems in connection with the dehumidifying of our warehouses.

During the fiscal years of 1947, 1948 and 1949 the Bureau of Supplies and Accounts prepared 67 World War II temporary warehouses for dehumidification at the four inland supply depots previously referred to. About 8,000,000 square feet of dehumidified storage space was thus obtained. We now have approximately five years of operating and performance experience and we believe we know how to do it and what our costs are for installation and operation.

While I shall rely upon our Chairman, Mr. George W. Higgs, Jr., of the Bureau of Yards and Docks to later respond to questions on installation and operational costs, I'll nevertheless give some very general cost indications at this time. As you have seen from the film, the cost of installation can be pegged fairly close to 40 cents a square foot, with five cents per year per square foot for maintenance and operation. Thus, the accrued cost in twenty years is estimated to be about $170,000 for a 200' x 600' standard Navy warehouse or - 120,000 square feet of space. This averages less than 8 cents per square foot per year. In the utilization of this warehouse, approximately 78,000 square feet can be occupied by stores to a possible height of 17.3 feet. This gives us 1,349,000 cubic feet or 33,735 measurement tons of stores. Including the initial capital outlay and somewhat less than optimum use of the space, we can assume a cost of 30 cents to 40 cents per measurement ton per year in a working warehouse.

However, the full economic value of the dehumidified storage program has not been evaluated, although such a study is currently under way. This study will involve recorded performance experience in the protection of stores; the costs encountered in cyclic inspections for the condition of material and cyclic-representation frequencies required by class of material stored in dehumidified warehouses versus conventional storage and the physical impact of dehumidification - if any - upon certain stores and types of preservation.

Included in this evaluation into the economies of dehumidified storage is a long range program wherein representative types of material, supplies and equipments are processed under the appropriate methods of MIL-P-116, which is the basic preparation, and subjected to various types of storage at both inland and coastal locations. These stores will be subjected to open storage, conventional heated storage, conventional unheated storage and to dehumidified storage.

A six month frequency sampling program has been established and for certain of the Bureau of Ships components, humidity sensing elements are included in the packs for external readings of all packs rather than a sampling inspection. From this we hope to establish firm criteria for cyclic inspection and cyclic represervation frequencies, by type of preservation for each category of storage.

However, there are interesting areas of experience that we can report as the result of preliminary evaluation studies to date. For example, at one of our depots where we are operating 14 buildings under dehumidification for the protection of some 200 million dollars worth of Navy-owned equipment, we know that the inspection frequency of average material commonly placed in non-dehumidified storage is once every 24 months. Against this, the inspection frequency of average material placed in dehumidified storage is once every 48 months. In projecting the economies, let me say that the approximate savings in this function is 600 man-hours per year per dehumidified storehouse or $14,475 savings each year on the cyclic inspection alone. At this same activity during a six months period only 12 per cent of the units requiring cyclic represervation were from the dehumidified warehouses which housed 42 per cent of the stocks. From this it can be seen that there is considerably less represervation and packaging effort expended on material stored under humidity controlled conditions.

Another inland depot having 170,000 measurement tons of material subject to preservation stored in dehumidified warehouses reports that the cyclic represervation requirement for material in dehumidified warehouses is only half that of material in non-dehumidified space. In this instance the annual savings are estimated at $107,000 by this depot after deduction of the cost of operating and maintaining the dehumidification program.

An interesting economical side light, and one that hasn't been explored too deeply, has to do with warehouse maintenance and heating costs. At one of our depots, where comparative costs of maintaining dehumidified buildings versus non-dehumidified have been recorded, it has been found that the cost to maintain the warehouses prior to conversion to dehumidification was $11,056, per year. The average annual cost under a dehumidified status is now $6,170 per warehouse or approximately $5,000 saved per warehouse. We have 24 buildings under dehumidification at this depot with savings in annual maintenance totaling $120,000. This saving in itself will be sufficient to amortize the initial cost of dehumidifying in less than ten years, and I believe that is pretty good business.

From the experience presented here, it is obvious that when all the facets of the economical impact of dehumidification are assembled, the resultant report will be of more than casual interest to the taxpayer.

In summation, the Bureau of Supplies and Accounts at the present time is operating 66 dehumidified warehouses with a gross square foot area of 7,913,000 square feet, providing a preferential storage environment for 1,397,000 measurement tons of material valued at more than $733,000,000.

Last February, the Chief of Naval Material established an Ad/Hoc Committee to evaluate the dehumidification program in the Navy and to make recommendations concerning its future. To date, this Committee - subsequently joined by representatives of the Army, Air Force, and Office of the Secretary of Defense - has devoted many days to its task. I shall quote from its interim report to the Chief of Naval Material:

"Summary of Findings: The Committee finds that generally the applications of dehumidified storage within the Navy have been successful, beneficial and economical. The Committee finds that the Bureau of Supplies and Accounts has approximately 8,000,000 square feet of dehumidified warehouse space located chiefly at the four inland supply depots and that the Bureau of

Yards and Docks has 480,000 square feet existing and 240,000 recently placed under contract at the coastal Naval Construction Battalion Centers. Bureau of Aeronautics has approximately 1,700,000 square feet of semiportable dehumidified structures utilized for storage of aircraft parts, and missiles. These dehumidified spaces constitute only a small proportion of the total storage space available to the Navy. Examples of dehumidified storage space at Yards and Stations are almost nonexistent, excepting the BuAer demountable structures. Machine tools, of industrial plants formerly engaged in production of military equipment and not currently required for production of civilian goods, are being entrusted to dehumidified storage at the plant site or at centralized storage points. The Committee finds that there is a need for dehumidified storage space at activities conducting overhaul and repair operations. The Committee notes that dehumidified storage does not protect stores during transhipment operations, therefore the level of packaging and applied preservation essential to the anticipated shipment conditions must be provided.

"Recommendations: The Committee recommends that the existing D/H program be continued. On the basis of information now available, the Committee further recommends that this program be expanded to include D/H applications of the following nature:

"(a) Wherever the use of D/H warehousing will permit an economical reduction in representation operations.

"(b) Wherever use of D/H storage can make a significant reduction in reactivation time and/or cost of items subject to humidity-caused deterioration.

"(c) Wherever deterioration, normally caused by moisture, can attack or materially reduce the potential value of items held awaiting repair, disposition, preservation or representation, and assemblies held for completion pending receipt of backordered components.

"(d) Wherever stores and equipments, subject to deterioration as a result of exposure to humid atmospheres, are held pending issuance for immediate use or further consolidation.

"(e) Wherever supplemental assurance is desired in addition to that afforded by preservative treatments and/or packaging.

"Summary: This Committee considers that the use of controlled humidity storage for most military stores provides significant benefits to the National Defense Program, particularly by providing a higher degree of strategic readiness and by an effective reduction in the over-all cost of that program. Accordingly, it is recommended that more emphasis and study be given to the use of controlled humidity storage at stateside and overseas storage, and repair activities such as Shipyards, Air Stations, and Ordnance Depots." Thank you.

Mr. J. H. Williams
Chief Production Equipment Branch
Office of the Assistant Secretary of Defense,
(Supply and Logistics)

The art of preservation of machine tools is a relatively young one, dating back only to the period after the end of World War II. Prior to that time only a handfull of machine tools had been held in storage for any extended period of time. At the end of World War II the national policy was to return our industrial economy to a normal peace time basis as soon as possible. Consequently, it was the policy of the Administration, at that time, to make available through government sale machine tools that had been used by the government and its contractors in carrying out the war production programs. Many thousands of machine tools were thus made available to the government disposal agencies. But in a relatively short period of time it was realized that the peace time industry of our country could not absorb the tremendous numbers of machine tools which had been required for the massive war production program. The problem which then confronted our top policy makers was what to do with the machine tools that could not be absorbed by industry. Also entering into the decision, at that time, was the realization fresh in the minds of the War Time Production Czars of the importance of the machine tools. The top group established for the purpose of formulating military production equipment policy at that time was known as the Joint Industrial Equipment Committee and it was this group that sowed the first seeds which led to the Reserve Tool Programs which we have today. The Navy and the Army, which at that time included the Air Force, joined forces in drafting what later became Public Law 364 of the 80th Congress and under this legislation the military departments were permitted to acquire from government surplus some 186,000 machine tools to be held in long term storage for use if necessary to augment those available in the civilian economy to produce military goods in the event of an emergency. Starting in early 1947, machine tool and production equipment acqusition from surplus under this program reached a rate of nearly 5,000 items per week. Eventually almost 135,000 items of production equipment came into the Departmental Reserves under this program and of this number roughly 60 per cent were machine tools and metalworking equipment items. Faced with this huge influx of production equipment crowding available storage installations, the Services were hard put to develop a program for the long term preservation of industrial production equipment. Practically no previous experience in this field by either government or industry was available as a precedent. Numerous theories

were advanced as to the proper method for machine tool storage and eventually more or less successful means of preservation were devised. It must be considered when discussing machine tool preservation that this kind of equipment by its very nature is difficult to protect from deterioration. Machine tools are constructed mostly of cast iron and steel alloys both of which materials are extremely susceptible to deterioration unless proper protection is given them. Normally their constant use from day to day in a production shop and the lubrication which is required by constant operation provides sufficient protection. The idle storage of such equipment provides a completely different problem. Considerable investigation was conducted with manufacturing concerns, both machine tool users and manufacturers, in regard to the proper method to be utilized in protection machined surfaces from deterioration. Many methods were proposed, many were tried, and through the experience gained over the years and the knowledge obtained through the Korean Mobilization we have now what we feel are highly developed methods of preservation. About the first successful method found to prevent deterioration was the application of heavy coatings of greases which were largely composed of a combination of petroleum products and paraffin. It was found rather quickly that unless the machined surfaces were absolutely clean before such coatings were applied they peeled off and exposed critical surfaces to oxidation. Another one of the disadvantages of this type of preservation is the difficulty of removing the coating prior to return of the equipment to use. It was found in the Korean Mobilization program that about the only practical method of accomplishing this coating removal was through the use of a vapor spray of a special type of dissolving agent. Means for spraying this chemical were of necessity large spray booths and the processing of machine tools through these cleaning booths often resulted in delays in getting the tools into productive use.

During this same period between the end of World War II and the start of the Korean Mobilization research had been going on by both the Army and Navy and later the Air Force in the use of Dehumidified storage. This is a means of storage of machine tools and other production equipment in an enclosure from which moisture is evacuated to prevent deterioration. It has been found that oxidation of machined surfaces and other critical items will not take place to any damaging extent when the relative humidity is held below 50 per cent.

A striking example of the effectiveness of dehumidification that comes to mind is one that took place in one of the early experiments by the Navy. The Navy had

built at the Naval Ordnance Plant at South Charleston, West Virginia, a few dehumidified huts. These were of the very earliest types and were simply a framework covered with cloth which had been sprayed with a material which made them air tight. A lathe of average size had been put into one of these huts and several bright new pennies had been placed on the ways of this lathe. The hut was then resealed. Over two years later the hut was reopened and the pennies were examined and did not show any sign of oxidation whatsoever, and they were just as bright as the day that they had been put in there. Furthermore, once they had been picked up from the ways of the lathe there was no mark whatsoever on this bright metal surface to indicate where the pennies had lain. In this case the machine had not had any oil film or preservative whatsoever placed upon it. Of course, it is my recollection that the humidity in this particular experiment was held to a lower relative value than we feel necessary today. The Military Departments under current procedures use about four different kinds of inclosures for dehumidified storage. The first and the smallest type of inclosure is known as a hut. This is generally a structure of a size sufficient only to inclose the machine tool or tools for which the protection is required. Huts are usually made inside of buildings but their dimensions have no relationship to the dimensions of the building in which they are placed. The second type of inclosure is a hutment and this constitutes the complete sealing off of the inside of a building and does not necessarily have any definite relationship to the dimensions or the floor space occupied by the machine tools which are to be stored. The third type of storage is a building which is constructed from the ground up specifically for the purpose of maintaining machine tools in a controlled atmosphere. The fourth and last method and incidentally the most recent addition to the list is the cave. At the present time the only caves that have been utilized are man made caves of such composition that they lend themselves to the controlling of the atmospheric conditions. Up to now there have been more huts constructed than any other type of inclosure used for dehumidified storage, but the total usable amount of space in these huts does not approach that available in the other three types of storage. Usually the specific storage site, including its geographical and climatic conditions, dictates the type of structure most suited to a particular installation. Naturally, in an installation where there are tools that have to be used from day to day along with other tools which are to be stored under dehumidified conditions the hut seems to be the best type of structure. On the other hand very often tools, under our present concepts, are stored in a separate

building on the site where they would be operated in the event of an emergency. These are usually machines that were used for production during the Korean Mobilization and are stored on the sites so that they will be almost immediately available to augment those owned by the proposed mobilization supplier. One of the great advantages of dehumidified storage is realized under this circumstance because of the fact that machines stored in a controlled atmosphere do not require the prior application of heavy preservative coatings. The light fogging with a light oil vapor is all that is necessary. This, of course, is very easy to remove when the tools are being reactivated and as a matter of fact can be left on the machine without doing any harm.

To give you some idea as to the extent and type of dehumidified storage in connection with machine tools currently in being in DOD, I will run over a few statistics, department by department.

In the Department of the Navy, dehumidified storage facilities for retention of machine tools are located at eight sites throughout the country. At these eight sites there are 36 huts and eleven dehumidified buildings. The Navy has no tools stored in caves at this time. The total number of usable square feet in these dehumidified storage areas is approsimately 1,000,000 square feet. These contain over 9,000 machine tools having an acquisition cost of a little over $98 million. The Navy is planning to construct additional dehumidified storage areas to allow for the storage of about 1500 additional items having a volume of approximately $13.5 million.

The Department of the Air Force is the last of the Departments to get into the dehumidified storage field and although only a limited amount of their storage is now under dehumidified conditions their plans include much more extensive use of this method. At the present time the Air Force has only one storage site where dehumidification is used and at this location there are five huts which house approximately 450 items having an acquisition cost of around $2 million. The total square footage of these huts amounts to about 28,000 square feet. As I said before the Air Force plans rather extensive use of dehumidified storage in the future and at the present time their program calls for the construction of approximately 2.5 million square feet of dehumidified storage area in buildings and huts. It is planned that these inclosures will house over 25,000 machine tools having an acquisition cost of $250 million. The Air Force, like the Navy, does not now have any caves in use for storage, nor is any such storage contemplated in the foreseeable future.

The Department of the Army constructed their first dehumidified storage hut in 1949. This was a building specifically erected for experiments in dehumidified storage but like the Navy this original installation contained only a few square feet of storage. The Department of the Army now has 61 dehumidified huts, six dehumidified buildings, one hutment and one dehumidified cave. The total usable square feet of dehumidified storage in all these amounts to about 5.6 million square feet and covers about 51,000 machines which are valued at more than $500,000,000. In addition to this the Army is currently planning for the construction of an additional 1.25 million square feet of dehumidified storage to house approximately 17,000 items having an acquisition cost of $200 million.

Most of the original huts were modeled after the cocoons which were placed around the big guns on Navy ships which were prepared for storage in the Reserve Fleet. This was a wrapping of light cloth, such as muslin or cheese cloth around a frame work which in turn surrounded the machine or machines. On top of this cloth was sprayed a pliable plastic coating, and a dehumidifying machine was arranged alongside of each shroud to remove moisture from the air within. While these original structures performed the functions of maintaining a dehumidified atmosphere there were several disadvantages encountered. Maintenance on this type of structure was high, and strength and fire resistance were low. The conclusion now reached by all three of the military departments is that--this is in regard to machine tools--metal huts have proven to be the cheapest to construct and maintain, offer the highest degree of safety to stored equipment, and have the longest effective life. The average cost of metal huts currently is from $0.95 to $1.25 per square foot and that of metal hutments is $2.00 to $2.50 per square foot (plus the cost of a concrete slab if required). These figures include the cost of the dehumidification equipment.

The dehumidified buildings are of masonry, double wall, sealed metal siding or concrete. The cost for a building runs from $4.00 to $8.00 per square foot including the dehumidification equipment. With normal maintenance a dehumidified storage building should be useful for 20 to 35 years, whereas, a dehumidified hut with roughly the same degree of maintenance has a useful life of not over 20 years. The huts have little or no practical use after the machines stored therein have been removed. Hutments have a limited practical use as emergency dry storage space, but the dehumidified building on the other hand will prove most

valuable for actual manufacturing operations. A number of such manufacturing operations exist within the production requirements of the Department of Defense. The production of optics and precision instruments, for example, as utilized in certain defense items requires very close control of the amount of humidity and dust in the atmosphere. In war time, it has been our experience that such space has, in the past, had to be especially constructed for this purpose.

The entire subject of preservation of machine tools and of long term storage is covered in a document known as Military Standard No. 107. This Standard is prepared by a Committee composed of the top technicians in the storage and preservation field. Before any method can be specified in the Standard, it is extensively investigated and tested, to determine its suitability for maintaining production equipment over a long period of time. The book not only covers preparation of machines for dehumidified storage, but also includes methods of processing machines for storage in open unheated and heated warehouses. Important things other than actual storage which must be treated and are covered in the book are items such as the blocking and bracing for shipment to prevent damage, the skidding of machine tools and production equipment, the amount of actual running under power that should be given machine tools that are stored in place attached to power lines and numerous other related factors. This book describes certain cleaning fluids, vapor inhibitors, desiccants, oils, greases, etc. All of these are items which meet approved Military specifications and have been developed with the assistance of Petroleum and Chemical industries. The compilation of this Mil. Standard for preservation has been a substantial undertaking and one that has required a considerable amount of give and take by each of the Departments in order to enable the establishment of a uniform standard. This objective has always been kept in mind because of the extreme desirability and insistence by the Office of the Secretary of Defense that a single uniform method of preservation be utilized by all three Departments. Our reason for this, aside from the inherent economy, is to simplify the problems of civilian firms contracting with more than one department. Without the uniform standard such a firm might have to stock two entirely different kinds or sets of preservatives for each of the Departments with which he contracts. This has been true in the past but we feel that much progress is being made for elimination of this condition.

The present policy of the Department of Defense is that machine tools will be retained against known mobiliza-

tion requirements, that those tools that we hold in reserve will be operable or will be made operable if they are required, and if they are not required they are to be disposed of. All equipment held in storage is to be reviewed at least every two years against requirements. We are developing a set of analytical test patterns which will be used to provide uniform tests so that the operating characteristics of all equipment held in Reserve storage will be known.

Our current policy is for tools to be retained at the following types of locations in the order of preference as follows: (1) at the point of proposed use, which actually means in line in the plant, where they would be used; (2) Adjacent or near to the plant where they will be used, but kept intact as a production package capable of rapidly being moved into production application; and (3) at central storage location. The last type of storage usually contains those machines which are held for contractors yet to be selected or for contractors that receive only a few machines.

A preference for the type of maintenance of reserve equipment is first in dehumidified storage, second, heated storage and third, unheated storage. The dehumidified storage could be either in huts, hutments, buildings or caves.

The only cave now in use as a storage site is operated by the Department of the Army and has proven to be well suited for storage purposes. The temperature within the cave is constant the year around and once dehumidified the maintenance in this condition is not difficult. An additional advantage of a cave is that after the tools have been removed a manufacturing or assembly facility may be placed there in comparative safety from bomb damage. Most of the caves available in the country have a large storage area, and the cost of converting them, including the installation of dehumidification equipment, is high. This is the major limiting factor in the expansion of this storage technique.

The Army, Navy, and Air Force have been working very closely and harmoniously in this particular field and the progress made in this relatively new area is tremendous. We now know of a number of ways of storing tools, free from deterioration, over an extended period of time, but our studies will continue as we seek out new methods to reduce cost, improve the preservation and assure the immediate availability of these machines for production in the event of a future emergency. Thank you.

Mr. W. F. Durbin
Goodyear Tire and Rubber Co.

I was asked to discuss the effect of humidity on the deterioration rate of rubber and plastic products during storage. From a practical standpoint humidity is not an important factor. Under prolonged exposure to very high humidity certain plasticizers used in plastics and rubber are attacked by fungus. Soden and Wake (1) have shown by both tropical storage and laboratory aging that the deterioration rate for valcanized natural rubber at humidities of close to 100 per cent is 1.85 times the rate of that in dry atmospheres. These high humidity conditions, however, rarely occur in warehouses of this country, and a deterioration rate increase of 1.85 is small compared to the damage that can take place due to heat or light cataliyzed oxidation. For example, a foam rubber mattress such as Goodyear's Airform will withstand deterioration for twenty-five years under normal use conditions, but will deteriorate in the first few days of exposure to sunlight.

We might ask how serious is the problem of deterioration of rubber and plastic products. Since each type of polymeric material has different deterioration characteristics, and these characteristics are affected by added ingredients, processing methods and storage conditions; no single set of data provides an answer. In instances which are, unfortunately, not as common as we would like, the rubber in tires and tubes have been found to be of usable quality after more than twenty years of service. I have a pair of rubber galoshes purchased twenty years ago that are in excellent condition in spite of storage conditions which have varied between that of the hot attic and the damp basement. Clothing items proofed with rubber have been known to last fifteen years. Industrial plastics of today, are, for the most part, of recent origin, and deterioration data for extended period of time are meager. The indications are that in the absence of extreme conditions, they will also have a good record.

The subject of rubber and plastic deterioration is well documented. One wishing to read on this subject might well start with "Deterioration of Materials" by Gleen A. Greathouse and Carl J. Wessel. Most of the literature deals with storage conditions which are abnormal in one way or another, and some conflicting views are found. There is general agreement concerning the harmful effects of high temperature, ozone, oxygen, and light, particularly direct sunlight. There is little evidence that humidity con-

trol would be beneficial in climates where extreme conditions rarely exist.

Since tires are a major rubber product, I would like to describe briefly the industrial practice for their storage. The tires should be protected from dirt, water, ozone, oil, heat, excessive weight and distortion. There is no standard warehouse design. The preferred type is a one-story building requiring no stairs or elevators. It would have no windows and positive ventilation. Warehouses may or may not be heated. When heating and ventilating facilities are provided, it is for the comfort of the worker rather than preservation of the rubber. Windows are often painted to prevent direct sunlight. No attempt is made to control humidity. Although passenger tires are still stored in stacked or laced piles, the trend is toward palletization. The pallet is a portable platform with a superstructure. Four stacks of tires are placed on the platform, and then the platforms are stacked one on top of the other. The superstructure prevents crushing of the tires by the pallets above. For military tires and tubes, there is a twelve-month limit or less on the manufacturer's storage period. For non-military tires and tubes, there is a forty-two month limit at Goodyear. Tires stored longer than forty-two months must pass a quality inspection before release. Recently, we inspected a quantity of seven year old tires and found all to be of a first class quality. I understand that military warehouses are permitted storage periods up to ten years.

A major part of the research work at Goodyear is directed toward the development of rubber and rubber chemicals which will give improved service to the finished product. We did, however, have an occasion to study a problem dealing directly with the storage of rubber and plastics. At the close of World War II, the International Harvester Company had a government contract dealing with the storage of surplus war goods. The Goodyear Tire and Rubber Company was awarded two sub-contracts by International Harvester to investigate certain specific problems in connection with the storage of rubber and plastic products. The effect of humidity was not considered important enough to be included in either investigation.

Under the first contract (2) 38 plastics, 18 rubbers, and 3 fabrics were stored in the absence of light, in both dry air and dry nitrogen atmospheres. Three temperature conditions were investigated:

1. 12 hours at -60 degrees F. followed by 12 hours at plus 90 degrees F. for 60 days.

2. 12 hours at -20 degrees F. followed by 12 hours at plus 170 degrees F. for 60 days.

3. 170 degrees F. for 60 days.

Storage containers were pressurized at 6-1/2 psi gauge pressure at 70 degrees F. in order to maintain a positive pressure at all aging temperatures. The nitrogen used had a dew point of -65 degrees F. or lower and an oxygen content of 0.06 per cent by volume. The air had a dew point of -34 degrees F. All storage containers contained 3/4 lb. of dry Grade A activated alumina. The conclusions from this work were as follows:

1. Repeated thermal shock from -60 degrees to plus 90 degrees F. does no appreciable damage to common rubbers, plastics, and textiles.

2. The materials showing satisfactory storage in either dry air or dry nitrogen for 60 days at 170 degrees F. were

Phenol Formaldehyde
Melamine Formaldehyde
Vinyl Chloride
Vinylidene Chloride
Vinyl Chloride-Acetate (flexible types)
Urea Formaldehyde
Cellulose Acetate-Butyrate
Methyl Methacrylate
Hard Rubber
Butyl Rubber
Polyethylene

3. Materials showing damage by storage in both dry air and nitrogen at the end of 60 days at 170 degrees F. were

Vinyl Chloride-Acetate (rigid types)
Vinyl Butyral
Ethyl Cellulose
Cellulose Acetate
Methyl Methacrylate (cast type)
Polystyrene
Cellulose Nitrate
GR-S Rubber
GR-N Rubber
Neoprene
Thiokol

4. The materials damaged by storage of 60 days in air at 170 degrees F. but not by nitrogen under these conditions were

Natural Rubber

5. Materials which showed a slight advantage of nitrogen storage were

Cellulose Acetate-Butyrate
Hard Rubber
GR-S
GR-N
Neoprene

6. Nylon, rayon and cotton were not damaged under any of these storage conditions.

In the second contract (3) the physical properties of some common rubbers were measured every ten days for a period of 200 days storage in both air and nitrogen at temperatures of 50, 70, 90, 110, 130 and 150 degrees F. The moisture in the air was maintained between 20 and 30 per cent measured at 50 degrees F. The nitrogen contained 0.06 per cent oxygen by volume and a dew point of -67 degrees F. or less. The air flow was .236 liters per minute, decreased 5 per cent for each ten-day aging period. The containers having nitrogen were purged to 0.2 per cent oxygen and pressurized to 4 in. mercury. The results indicated no significant advantage of storage in nitrogen. The results for the samples stored in air are given below. The days of satisfactory storage are given for each temperature.

Compound	70°F.	90°F.	110°F.	130°F.	150°F.
Natural Rubber Tread	200	200	180	40	10
Natural Rubber Tube	200	200	200	200	20
GR-S Tread	200	200	70	20	10
GR-S Bogie	200	200	60	20	10
GR-N Fuel	200	200	60	30	10
GR-N Hose	140	20	10	10	10
Neoprene Fuel Hose	200	200	120	100	10
Neoprene V-belt Cover	200	200	60	20	10
Butyl Tube					190

In commenting on the results of this work, it should be pointed out that oxygen is a factor in the deterioration of rubber in spite of the fact that no significant advantage is found for storage in a nitrogen atmosphere. This merely

means that it is impractical if not impossible to exclude all oxygen. The 0.2 per cent oxygen content in the nitrogen atmosphere plus oxygen dissolved in the rubber was sufficient to cause degradation.

To summarize, although rubber and plastic products can be degraded by extreme conditions of heat, light and humidity, the rate of deterioration under warehouse storage conditions is very slow. Protection against heat and light are most important. Since very high humidities so rarely exist, little would be gained by humidity control. Although oxygen is a factor in degradation, it cannot be excluded sufficiently to justify storage in inert atmospheres such as notrogen.

I might say that although humidity control we don't consider important for the storage of rubber, we would also say there would be no damage done by humidity control, where it is necessary to control the humidity for the protection of other components of the article. Thank you.

Mr. J. DeGroot
Industrial Engineering Section
Detroit Arsenal

The present day processing and outdoor storage of military vehicles in accordance with basic instructions of SB 9-4 supplemented by the Detroit Arsenal Purchase Descriptions for each category of vehicles, requires continual, extensive and expensive maintenance-in-storage operations, and complete reprocessing every three years.

Furthermore, without close surveillance, which incidentally involves considerable manpower, the results accomplished, in many instances, are either inadequate or questionable.

In a conference with Office, Chief of Ordnance, in October 1953, the need for a practical, adequate and economical approach to the storage of military vehicles was emphasized on the basis of the following information that came up for discussion at the conference.

During 1949, 1950 and 1951 an average of $410,000,000 was spent annually for spare and replenishment parts for rebuilding approximately 150,000 Army Ordnance vehicles in storage.

Maintenance in storage averages $8,200,000 annually on these vehicles for the same years.

If only 10% of the total cost of $418,200,000. for one of these years could be attributed to inadequate protection resulting in corrosion and deterioration, and this is a very conservative estimate, the expenditure of $41,820,000.00 for ultimate protection could be well justified.

A review of the files relative to long term storage of Ordnance material after World War II was accomplished to avoid duplication of work and unnecessary expenditure of funds. Many of you here today are, no doubt, familiar with projects undertaken in this field by Arthur D. Little, Batelle Memorial Institute, Davison Chemical and International Harvester from 1945 through 1948. A summary of their findings will follow.

ANALYSIS OF PROBLEM

1. Protect metallic components from corrosion and minimize deterioration of non-metallic components in military

vehicles.

2. Detrimental elements to consider are basically sunlight, humidity, oxygen, and high temperatures.

3. Best method will be a compromise between strategic, economical, and technical factors.

4. Methods previously evaluated:

a. Underground caves or mines.
b. Unconditioned warehouses.
c. Dehumidified warehouses.
d. Dehumidified oil storage tanks.
e. Individual containers (shippable and non-shippable)
f. Use of inert gases.

5. Disadvantages of methods shown previously:

a. Underground mines or caves. - Entrance facilities, strategic locations, real estate complications and transportation costs of vehicles.
b. Unconditioned warehouses. - Undesirable high humidity and high temperatures, also availability.
c. Dehumidified warehouses. - High costs.
d. Oil storage tanks. - No more available, high cost of erection, no space for exercising, difficult loading and unloading and not too easily dismantled.
e. Individual containers (shippable and non-shippable). Exorbitant costs.
f. Use of inert gases. - Special equipment, high costs, impractical.

I might explain that in regard to item 5c, the Army Ordnance does not have any Dehumidified warehouses existing or that could be modified for D/H that would be available for vehicles. So the point here is to erect new warehouses in the sense that we call them that--that would be high costs.

The oil storage tank program, item 5d, was actually developed in '45, when the military had on hand several of these oil storage tanks. They were bolted and gasketed, usually of the 10,000 barrel type, which meant they were 24 feet high and 55 feet in diameter. They also had the 5,000 barrel type 30 feet in diameter and 24 feet high. Ordnance obtained some

of these excess oil tanks and modified them to provide a tank approximately 11 feet in height. In these we stored a high category of vehicles from '46 to '50.

Dynamic dehumidifier machines of 500 CFM capacity were hooked to a series of ten tanks. Machines of 20 CFM capacity were hooked individually to each storage tank.

These findings and experience in the newest programs on dehumidified storage led to the following conclusions: Dynamically dehumidified storage of military vehicles, with limited processing and exercising of certain components through external controls will provide ultimate protection at the lowest possible cost.

The objectives of our April 1954 project were to:

1. Determine the most economical type of shelter suitable for dehumidified storage of combat vehicles.

2. Determine minimum acceptable floor requirements.

3. Determine types and sizes of dehumidifiers best suited as well as instrumentation.

4. Determine whether under dehumidified storage there actually exists any need to exercise components of the vehicle, and if so, to what degree, and with what type of equipment.

5. Develop surveillance, maintenance-in-storage, exercising and servicing procedures determined

At the present time, a contract is in effect that will cost approximately one-and-a-quarter million dollars to accomplish the modification of the circular oil storage tanks I mentioned before. This will include the installation of doors, resealing of all openings, and replacement of large dehumidifiers with small units for each storage tank. The primary intent for this program is for the long-term storage of high value low obsolescense vehicles such as the M48, M41 and M42 tanks.

In carrying out our study of shelter requirements we purchased a prefabricated metal shelter consisting of steel framing, corrugated aluminum sides, tops, ends and flashings with aluminum screw type nails as fastening devices. Sealing at all joints, seams and overlaps is accomplished by the use of a specially made neoprene rubber gasket designed to fill the void spaces of the corrugations and also by the filling of other voids with a suitable caulking material with good weathering qualities and low resistance to contraction and

expansion.

To substantiate our opinion, of ultimate protection at the lowest cost, it was necessary to obtain approximate cost figures of our present day processing, basically covered by SB 9-4 and subblemented by the Detroit Arsenal Purchase Descriptions. Therefore, costs of initial processing and maintenance-in-storage reprocessing were obtained from three manufacturers of M48 tanks, in 1953. The average compelation of these costs was:

Initial processing	$ 500.17
M.I.S. reprocessing every 90 days	$ 367.84
Total cost per vehicle for 3 years storage (12 x $367.84 ≠ $500.17)	$ 4,914.25
Total cost of processing and storage of 16 - M48 tanks for 3 years	$78,628.00

We have a maintenance-in-storage operation, every 90 days, so it would be 12 times over a period of three years, plus the initial costs for processing.

The number 16 is used as the basis on this evaluation, because the shelter just described will accommodate 16 M48 tanks. So all through this evaluation the number of tanks will be sixteen. Normal maintenance-in-storage programs pertaining to military vehicles and outdoor storage usually include a monthly inspection for visible exterior damage to the vehicle. Examination and exercising of major components, such as engines and recoil mechanisms is conducted on a 90-day basis. These activities require the removal of the processing materials, such as tape and vinyls and removal of the watersheds. Periodical exercising is completed by replacement of the watershed, and complete reprocessing.

In addition, there is time consumed in warm-up and cooling off periods for the engine. Special tools are required in the form of porto-power units and portable processing units.

Labor, material and equipment costs, as submitted by Lima Ordnance Depot, for processing, installation and exercising 16 combat vehicles in dehumidified storage were as follows:

1. Initial processing costs including installation into shelters which involves blocking up of vehicle on metal stands used in the oil storage tank program in 1946 $ 52.00

2. Labor costs for exercising each vehicle 2-man crew for 15 minutes or 1/2 man-hour $2.44

3. Total labor cost of exercising each vehicle for 3 years (12 x $2.44) $29.28

4. Cost of equipment for exercising $4400.00

   a. Electric porto-power hydraulic pump - $ 450.00
   b. Diesel cold starting slave kit - $3200.00
   c. 1/3 H.P. 24-volt electric gear head motor with sprocket drive - $ 750.00

5. Labor and material costs for processing and storage of 16 - M48 tanks for 3 years 16 x $52.00 + 16 x $29.28 + $4400.00 $5700.48

The three pieces of equipment listed, exercise the recoil mechanisms, engine, transmission, forward controls, elevating mechanisms, and suspension on the light tanks, and all but the suspension on the medium tanks.

The approximate cost of all the material, equipment and labor necessary for the erection of the 16 tank shelter and the installation of the dehumidifiers and instrumentation therefore, was less than 1/5th of the cost of maintaining the 16 tanks for three years under conventional processing. For less than 1/3 of the cost of conventional processing we were able to construct a minimum shelter and process and maintain 16 tanks in operational readiness, by means of dehumidification, for three years. The actual cost of the test installation of the dehumidified shelter was as follows:

Supply and erection of shelter 60' wide, 120' long, 12' high	$11,889.00
Installation of footings	$ 1,834.00
Labor, equipment and material to provide electricity to shelter, including wiring and fixtures	$ 611.00
2 - 100 CFM Desomatic dehumidifiers	$ 1,190.00
1 Hygrothermograph	$ 156.30
2 Humidistats	$ 30.84

Labor, equipment and material for hooking up instrumentation	$ 160.00
Total Cost	$15,871.14
Cost per square foot	$ 2.20

On this test installation, we arrived at a cost of two dollars and twenty cents per square foot on hard standing at the Lima Ordnance Depot. Volume procurement, erection and installation of shelters dehumidifiers and instrumentation should bring the cost close to $1.75 per square foot.

The comparative costs of preservation by SB 9-4 and D. H. for 16 M48 tanks for 3 years are:

SB 9-4

Initial processing (16 x $500.17)	$ 8,002.72
MIS reprocessing (12 x $367.84 x 16)	$70,625.28
Total Costs	$78,628.00

D. H. STORAGE

Complete labor, material and equipment costs for shelter, dehumidifiers, instrumentation, including erection and installation	$15,871.14
Equipment costs for exercising	$ 4,400.00
Labor and material costs for processing & exercising	$ 1,300.48
Total costs of D. H. storage	$21,571.62
Difference between D. H. and SB 9-4	$57,056.38

To go a step further, comparative cost figures were actually compiled on a ten-year basis. It is realized that the figures on maintenance operating and power consumption costs are not included, however, it must be noted that test installation costs are included for dehumidified storage and, as pointed out on the previous slide, a considerable decrease in cost would result from volume procurement.

SB 9-4

Complete processing every 3 years (3 x $500.17 x 16)	$ 24,008.16
MIS reprocessing every 90 days (37 x $367.84 x 16)	$217,761.28

Total processing and MIS reprocessing costs	$241,769.44
Cost per vehicle	$ 15,110.59

D. H.

Complete labor, material and equipment, costs for shelter, dehumidifiers, instrumentation, including erection and installation	$ 15,871.14
Equipment costs for exercising	$ 4,400.00
Initial processing (16 x $52.00)	$ 832.00
Exercising costs (40 x $2.44 x 16)	$ 1,551.60
Total Costs	$ 22,654.74
Cost per vehicle	$ 1,415.92
Difference in cost per vehicle	
SB 9-4	$ 15,110.59
D. H.	$ 1,415.92
Difference	$ 13,694.67

Based on all this information, our conclusions and recommendations were that we should:

1. Divide vehicles into categories relating to availability for immediate combat service.

2. Utilize to the fullest extent the existing 1,500,000 square feet of dehumidified petroleum tank storage at the seven depots, namely Lima, Red River, Letterkenny, Tooele, Mr. Rainier, Anniston, and Sierra, for storage of smaller Ordnance items than vehicles.

3. Divide the vehicles into categories of low, medium and high obsolesence to establish a War Reserve so that emphasis can be put on a determined quantity of the most important vehicles.

4. Based on data already compiled up to date, effect volume procurement of proposed shelters and equipment for the most important vehicles.

5. Store as many vehicles as is strategically and economically possible in areas such as Arizona, New Mexico, Utah, etc., so selective ventilation can be utilized in the dehumidified shelters.

6. Consider DAPDs or SB 9-4 methods for shipment and interim storage not exceeding 180 days.

We are continuing the long term storage project at Lima Ordnance Depot in order to refine the many details that can not be answered at the present time, such as:

a. Evaluation of other shelters.
b. Evaluation of other floor requirements
c. Evaluation of various types of insulation for the shelters determine whether their use is warranted.
d. Evaluation of various types of sealers in actual application on the shelters.
e. Evaluation of other types of equipment for dehumidifiers, instrumentation and exercising.
f. Evaluation of vehicles not exercised.
g. Evaluation of preservative materials as compared to regular operating oils and greases.
h. Obtain power consumption, maintenance and operating costs on entire project.

From the preceding information it is apparent that an M48 vehicle, for example, can be preserved and adequately maintained by the proposed method for ten years at approximately $1,500. Therefore, the cost for 2,000 M48 vehicles would be $3,000,000. When compared to present day processing, outdoor storage and necessary maintenance-in-storage operations at $15,000 per vehicle or $30,000,000 for 2,000 such vehicles, it is imperative that a volume program as proposed be initiated as soon as possible. The Arsenal is of the opinion that sufficient information has been obtained to warrant such action. As improvements in any phase of the proposed program are tried and proven in a continuing test project, they can be incorporated into production at the most appropriate time. Thank you.

MR. HIGGS: In addition to the people who have made presentations, there is a wealth of talent here this morning. I think we can take on all comers questions.

MR. LLOYD (Yards and Docks, Navy): Has Mr. DeGroot stored any trucks or vehicles of tactical type? Has he any pictures of that?

MR. DE GROOT: We have another program on for tactical vehicles that time did not permit me to mention. We are evaluating cocooning types, and we have run into a phenomena that is quite interesting. We might call it osmosis packed, where the pack keeps the moisture out and only lets the air in.

CAPTAIN PELTIER: (Bureau of Yards and Docks, Navy) I would like to know where the location is.

MR. DE GROOT: This is the Lima Ordnance Depot, Lima, Ohio.

CAPTAIN PELTIER: Both?

MR. DE GROOT: No, sir; cocooning is at Raritan Arsenal, Metuchen, New Jersey. I would say clear through Office, Chief of Ordnance, before any visits are made to these projects.

MR. LEVY (BuOrd, Navy): I have--I don't know whether you would say this is one question with three parts, or three separate questions. The first question is, what is the relative humidity that is maintained in these storage centers of yours? I would like to give them to you one at a time.

MR. DE GROOT: Those are directed at me?

MR. LEVY: Yes.

MR. DE GROOT: In the Lima project, 35 per cent is what we have set on the humidistats. We have a seven day hand wound hygrothermograph, and a check of those weekly charts that are removed from the hygrothermograph indicate we are not having any trouble at all to maintain a 35 per cent relative humidity.

MR. LEVY: Well, the second question is, you speak of instrumentation, what type of instrumentation do you have?

MR. DE GROOT: Well, instrumentation to us is an operations recorder to record the operating time of the equipment, of the dehumidifiers; hygrothermographs, as you know, are to record the temperature and humidity, and humidistats to start and stop the machines.

MR. LEVY: The third question is, of course, you have various rubberized materials with the equipment. I was just wondering if any effect on these rubberized materials has been noticed, particularly in low humidities.

MR. DE GROOT: Not in this program, because the actual buildings were completed in December, '54. I think that might be directed at the man from Goodyear. He might have a little more information on that.

MR. HIGGS: Mr. Durbin?

MR. DURBIN: I would say that the deterioration that took place was not due to the low humidity; it was due to other causes.

MR. LEVY: Thank you very much.

MR. KENNEDY (Cadillac Tank): I want to ask Jim, is it necessary in the new type of shelters, Jim, to use some type of static desiccant for pull-down or is the dynamic unit able to do that?

MR. DE GROOT: I might answer that—when we did the pull-down, it was an empty shelter. I do know that where there is stored equipment, such as production equipment, using a lot of wood dunnage, you have two choices; to increase the capacity of the dehumidifiers or you let them operate for a longer period of time. I think the machine lay-away boys can answer that better, but I will admit the initial pull-down on our project at Lima was done to an empty shelter. When we put the materials in, we had very little hydroscopic material in these tanks. We were even using steel blocking. Does that answer your question, Bob?

MR. KENNEDY: Yes. I am thinking about your tank program, your oil tank program, where you put 20 CFM units in now, individually, and you stick four or five vehicles in that?

MR. DE GROOT: Yes.

MR. KENNEDY: You still can't get it down with a unit; can you?

MR. DE GROOT: Well, they are installing DORS (dehumidification machines manufactured by Desomatic Products) and they may use larger DORS for the initial pull-down; that is very possible.

MR. HIGGS: Questions? I represent the Bureau of Yards and Docks, Navy, or, rather, that is where I work, and the group with which I am associated does the shore construction work for the Navy and the Marine Corps. My own particular branch handles the construction of warehouses and supply depots for both Marines and the Bureau of Supplies and Accounts.

The question is often put to us as to what the cost of dehumidified warehouses is, and some of the figures that have been presented this morning come from our experience. We are under a statutory limitation of six dollars a square foot for a warehouse, and recent estimates, bids, rather, have indicated that we can build a permanent warehouse with floor at grade level for a budgeting figure of six dollars a square foot, including a modest amount of roads and tracks in the vicinity of the warehouse.

If we go to a platform-height warehouse, where the floor is at the truck-bed level, the cost is somewhat more, but we can still meet the statutory limitations. Storage people are, it seems to me, over-concerned with the cost of providing dehumidified storage. I think if you will take Mr. De Groot's figures and extend them a bit into a ten year period, it will become rather inconsequential as to whether his warehouse costs two dollars a square foot, $2.20 a square foot, $1.75, or whether it would cost four or six dollars a square foot for a good storage structure.

The savings that he has indicated as compared to maintenance in open storage would amortize the structure quickly, at either two dollars or four dollars, or six dollars a square foot. It is possible that some of the locations where we have storage depots, such as the Marine Depot in the Mojave desert--that maintenance and storage costs are not comparable to those which Mr. De Groot has stated for the locations in which his data was based. At Barstow you have got dehumidified storage by grace of nature, much as the ancient Egyptians got theirs. However, we can provido the dehumidified storage--I say we, the engineering organizations of the military, can provide the necessary climatic conditions within your storage space, and I think do it economically. The main problem is to determine what the costs are of doing the job of maintenance and storage without dehumidified storage, and what the results might be with dehumidified storage.

The Navy Committee to Evaluate Dehumidified Storage which I Chair, and which was referred to by Mr. Rodenbaugh, has been expanded, at the request of the Assistant Secretary of Defense for Supply and Logistics, to include the Department of Defense, Army, and Air Force representatives. We have recently submitted a report which indicates that the military could use, in our opinion, about 52 million square feet of dehumidified space. So far as I have determined, we have in the military approximately 15 million square feet of that space now. That would indicate that we need maybe 37 million more square feet of dehumidified storage space. A good deal of that, I think, can be done by conversion of existing warehouses; some of it would require new construction.

In the opinion of the Committee, and other information which we have been able to collect, we think that by activation of this amount of dehumidified storage area we can realize a savings, after amortization of capital dollars, of about two dollars per square foot of dehumidified space.

If we are right in our appraisal of that situation, a few cents more or a few cents less per square foot for dehumidified space is not of very much economic importance. A saving of two dollars per square foot, of course, will amortize a six dollar square foot structure in approximately three years. That is the statutory limitation in which we are currently placed for new construction. It would not be nearly so expensive for most storage structures I have seen, to convert them from conventional warehouses to dehumidified warehouses.

The structures at Naval Supply Depot, Mechanicsburg, Pa., on which our film was based are warehouses that we built during World War II, a lot of them wood frame buildings. When we tackled the job of dehumidifying them we had a great many apprehensions, but we have been able to continue to maintain a relative humidity of 40 per cent or slightly less in those structures, for a very economical operation cost. The average is about $4,856 a year for maintenance of the dehumidification equipment, its operation and maintenance of dehumidification features of the building.

As Mr. Rodenbaugh said, they have realized other economies in the maintenance of the structure generally, which offset that approximately five thousand dollar cost of operation of dehumidification features. I am sure the engineering services of the military are willing and anxious to help any of the storage—management bureaus with their problem of providing dehumidified storage space, and the

Secretary of the Navy has requested that the management bureaus of the Navy determine what material they have which is eligible for dehumidified storage and present that information to the Chief of Naval Material, who will present it to the integrated Committee to Evaluate Dehumidified Storage. So we hope to present an all-inclusive report for the Navy Department in that respect. Since the Committee has been augmented, if the other services care to join in the presentation of that information, we will try to get up an integrated report for the military departments.

Are there any other questions that we can answer for you at this time?

MR. LLOYD (BuDocks): I have a question for Mr. DeGroot, will he give us a little on his stock exercising of automotive equipment as stored in DH, jeeps, trucks, and that type of thing, rather than tanks?

MR. DE GROOT: Well, there appears to be a difference of opinion relative to exercising the components of trucks, but it is my personal opinion that for the money invested in the exercising of components like the recoil mechanism, turret controls, elevating mechanisms, engine and final drive of tanks, that it sure will not do any harm, and I think it will do some good.

Actually, we lubricate the mating surfaces and there are various other advantages to gain from exercising of those types of components. I know they had a program on it for the Air Force which they were using for exercising of the tactical vehicles. There again, I think for the money expended, it is well worth it.

MR. E. R. QUEER (Penn. State): I would like to comment on something I have noticed, the trend here, in this dehumidification work; the humidities that are being recommended to preserve equipment have been gradually creeping up. Captain Donald, we will recall that we started with a 30 per cent humidity as a safe humidity for shipboard installation and 40 per cent for warehousing purposes. The reason for the difference was that the diurnal temperature fluctuation in the warehouse was much less than it would be aboard ship. In the caves, where the temperature condition is relatively stable, we are recommending 42 per cent relative humidity.

Now, I notice a trend to go to 50 per cent relative humidity. I think that is an unsafe condition. Army Ordnance

is using it, it is true, for heated warehouses, but they are taking an element of risk for that purpose, where they don't want to spend the funds necessary to install the dehumidification equipment. That is, the desiccant type of dehumidification.

There is another point I should like to direct your attention to, the matter of use of insulation in hutments. This comes back into the picture repeatedly, but very little has been mentioned about the use of the white surfaces on the outside of the hutment. If you will recall, oil companies are using very excellent white paint on the exterior of their tanks, just for this purpose, cutting down diurnal temperature changes. I suspect this might have an excellent application for military storage.

Another point touched on was the matter of having dunnage in these hutments, particularly where they were exposed to water, and the diurnal temperature change, daily temperature change is a rather important factor. It can vary widely.

If there is adequate dunnage, this can tend to stabilize the condition, without causing any condensation in the material.

CAPTAIN DONALD: I would like to say one or two words. I have been out of this game for a long time, since '46, as a matter of fact, although I was out at Lima when they mentioned the start of those oil tanks, for instance.

The Navy built in '39 and '40 what I think is probably the first dehumidified warehouse, up in Philadelphia. It was built to take care of the submarine battery condition. We had lost all the batteries we had there we thought we were going to use for SR, O boats, in World War II. The roof was leaking, the doors were corroded at the bottom, and what not. The average condition of warehouses--when you get into dehumidification, at least it keeps the roof dry and at least it keeps the windows closed, and things of that sort. That warehouse, incidentally, is not being used now, I believe?

MR. HIGGS: So I understand.

CAPTAIN DONALD: Carrier machines in it. When the initial thing started, the only people that I remember that knew anything about this were Cargocaire and Electro-Dryer, Cargocaire on ship and Electro-Dryer in the warehouse--trying to get them interested in that at that time.

Of course. the war came along and this thing fell--it had to be reborn, after the war was over. You haven't

mentioned the important--you talk about machine tools, steel surfaces, and things of that sort, for instance, when we dehumidify a ship, we dehumidify every kind of material you can think of, not only rubber, drawings, records, things of that sort, which in ordinary storage would deteriorate to the point where they are absolutely unusable even in two or three years, in ordinary storage, whereas in a matter of ten to fifteen years, they would be absolutely no good.

We keep all those things on a ship--even toilet paper, which the American seaman wouldn't go to sea without. I had occasion to get 70 destroyers recommissioned in San Diego, and we couldn't even get started, because we had no hand tools, no screw drivers, no monkey wrenches, no kerosene in quantity to get the grease off the machinery. At any rate the dehumidification, I think, is even more important for all things other than steel surfaces.

Now, we were never able to persuade the Maritime Commission, for instance, to use dehumidification on their ships. They had a test in about '47, '46 or '47, I think it was--you remember that? Up at New York? They decided against it, decided it wasn't any use. They say now they are doing pretty well. Of course, they take all the stores off the ship, for one thing, and they haven't got all the electrical equipment and delicate instruments and things we have. In the old days we used to strip the gauge board, in an engine room, and put that in a storehouse.

Talking about exercising tanks, we wrote into the original regulation a prohibition on jacking any machinery. I frankly don't believe that exercising is worth a darn, and I think how many years is it going to take you to find out about it. It saved us no end of labor, no end of cost. It is a very expensive thing. In addition, we used a polar compound preservative that we picked up from the Bureau of Ordnance, and--that was before the war, that we picked that up.

Incidentally, this all started around about '38 and not after the war. We used that thin film preservative compound, in order to take care of the time you wanted to make repairs and things of that sort. That stuff did not have to come off. I think it has been very successful. I don't know whether or not that is being used. For instance, you saw them going around spraying the new machine tool in storage. What the heck good does that do? I don't think it does any good. You fog that stuff around, and you are not getting it on the inside. There is a question in my mind as to whether or not it is worthwhile.

As far as the initial drying is concerned, that this gentleman mentioned, we don't bother about that, just start the regular dehumidifier, and that will maintain status quo after you go in; isn't that correct? We don't put extra capacity in purposely in order to bring down the humidity quickly. I think that is of very minor importance.

But it is a fact--you mentioned dunnage. I talked jokingly of getting a bale of cotton and spreading it out over the engine floor plates, to let it take the bounce.

This can go on--but even now I hear you talk, and you are still just getting started in it.

MR. HUMMEL (BuMed): Are all the vessels in the Reserve Fleet dehumidified with the stores intact?

CAPTAIN DONALD: Absolutely--I believe I can say so. Open boxes are left in bins; everything is left on board. The only thing that originally was taken off was gasoline and alcohol.

MR. COLVIN (Cargocaire): There are three comments I have to make, two of which I got from the talks.

I notice that in some of the figures shown, the cost of the dehumidification equipment was only about five per cent of the cost of the total installation, and so the money is in the building, rather than the equipment manufactured.

I was afraid someone would get the idea that the cost was in the machinery. It is very little, as far as the machinery is concerned.

Then someone mentioned that the packages which have bags of silica gel or activated alumina in them, if they are put in dehumidified storage, they are ready to go with full capacity when they leave that storage, rather than being almost exhausted.

By the same token, the Navy should consider the dehumidified ships that are their cargo ships, MSTS ships, because you may be a month or so in public quarters and want to have it go ashore full charge. The Navy is a little slow on that.

To back up Captain Donald--we started together in '38, ourselves--these Maritime ships that are laid up do deteriorate. I was on the train talking to a Westinghouse

man who had come from the two-tanker, which is electric drive, and they tried to put this ship which was out of commission, had been out a matter of two years, back, and it was a $164,000 job, just on the electric drive, because the rotor winding and everything else was so sopping wet--and you can do a lot of dehumidification for $164,000.

MR. HIGGS: Mr. Colvin is with Cargocaire. The representatives of other dehumidification manufacturers are here, and I would just like to introduce them so that any of you who wish to talk with them will know who they are. They have also left some of their literature here on the table. A good deal has already disappeared.

Mr. Hass, of Dryomatic, would you rise so the gentlemen can see you? George Simpson, Pittsburg Electric Dryer. Gunner Asker, Desomatic Products. Have I missed anybody that is here representing dehumidification machine manufacturers?

LT. COMMANDER ALLAN (ASO): I would like to ask Mr. DeGroot his opinion on the frequency of exercising equipment stored in DH storage. From past experience, we have had more or less of a costly--considered a very costly program, due to the fact that it necessitated a deterrent to DH storage--removing spark plugs of gasoline jobs, and injectors on diesel equipment, and many times exhaust systems had corrosive gases left in or moisture, and removing valve cover plates, venting crankcases, draining radiators, gasoline fuel pumps, carburetors. Considering all those facts, I would like to know what frequency he would recommend in exercising general equipment.

MR. DE GROOT: In my presentation I indicated that it was the opinion of several Ordnance personnel, based on previous study and over-all analysis of the subject matter, that we thought that periodical exercising of certain components of combat vehicles was justified.

Getting back to my talk, we have worked out exercising procedures with this equipment that amounts to about two dollars and forty-four cents per vehicle every 90 days. But in order to back our opinion in a continuing test program at Lima, we are evaluating exercised vehicles against non-exercised vehicles, and also certain stages of no processing up to the processing of the engine where we think we will have to combat the products of combustion, so that is all the information I have right now.

We are going ahead with the evaluation of exercised vehicles against nonexercised vehicles. It may take us one,

two, or three years. We have torn down these vehicles that we have in these outside hutments that I described in my presentation, and we have photographic evidence of every deficiency in the vehicle before they were put in.

Now, we may tear them down in one, two, or three years, and compare the results obtained from exercising as against nonexercising, as well as using the lubes that are involved in the vehicles against the preservative compounds. Does that answer your question?

LT. COMMANDER ALLAN: Yes, sir; thank you, sir.

MR. W. F. PINE (Dri-Store Facilities, Washington): We, ourselves, are interested in design, construction, maintenance on dehumidified storage facilities. A good deal of this discussion has been focused on long-term storage of military vehicles and military equipment. I would like to ask Mr. Rodenbaugh who, I think, has had a great deal of experience--or would have the most experience, probably--what his opinion is on the advantages of dehumidification in active warehouses; that is, in-and-out warehouses, rather than long term. Is there any advantage to be gained?

MR. RODENBAUGH: We believe there is a very definite advantage to be gained. I spoke of some of the activity, or, rather, I didn't speak of activity in these warehouses. For instance, in these warehouses at Mechanicsburg, we have a great deal of activity. I have records here of the door opening time, tonnages brought in, and the tonnages taken out. I think they are quite significant.

For instance, last year, Building No. 7 at Mechanicsburg--we handled 14,686 tons in, and 6,091 tons out, The tons handled per hour of door opening time were 70. That is an active warehouse. It isn't one where the doors are left open all day long. But, at the present time, we are confronted with the building of buildings outside the continental limits of the United States. The location is one of the worst in the world. The activity will be--it will be a rather active base. We are at the present time planning on preparing all the buildings for dehumidification and installing dehumidification in one of the buildings.

In the arrangement of the stores at this base, we are planning to put these slower-moving items in the DH warehouse. I will say that a great deal of the opposition to dehumidifying an active building is one of a lack of education.

The storage operators believe that you should only dehumidify dead storage space. Gradually we will overcome that situation, I am sure.

But, in so far as those of us who are concerned basically with preventing deterioration of material, we believe that dehumidification of active warehouses is supplemental protection we can give very economically to our stores.

MR. HIGGS: Thank you very much, Mr. Pine, for the question, and Mr. Rodenbaugh's answer. I was concerned that the topic might not come up, and I am glad it did.

MR. QUEER: Possibly we can get Colonel Cook to comment on his experience in the Transportation Corps with preservation of some of the things he had to deal with, and in the light of some recent emergency experience that arose.

COLONEL COOK: Cook is my name; I am just retired from the Army. I was with the Transportation Corps. I was given the assignment to tie up some locomotives for storage for ten years. We cocooned the locomotives, put a metal pan, an 18 gage pan on the base, cocooned it with a roof on top, with ample circulation of air.

The longest one was in about two-and-a-half years. As a result of an emergency in New England, the Transportation Corps offered forty of these locomotives to the New York, New Haven, and Hartford, I think it was, and they were given 48 hours to depreserve and get those locomotives into operation.

I understand from some of my friends at the depot that they met the deadline, they were able to get them out and get them rolling in 48 hours. We had a schedule of reprocessing those locomotives at the time we put them up. It was practically a situation of servicing the units prior to when they went in. From my understanding, they have operated all successfully.

MR. ASKER (Desomatic Products): I might add in that program of preserving the diesel locomotives, they had an internal volume of about 8,000 cubic feet, and there was used a small package unit of 20 CFM capacity that was discussed previously, and the cocoon was supported with quite a bit of woodwork, which had a high moisture content when we started to put the machines on the package, and calculating

how much moisture we had to remove--it would take at least three months of operation to pull the package down, but it only took about 20 days.

The reason for that is that the diffusion to the outer surfaces of the wood is comparatively slow. You readily evaporate the external layer of moisture, but you have a slack, because this diffusion is rather slow.

There is another consideration too. In reference to pull-down, if you can time your period when you put the machines on the stream, you should do it in the spring or summer or in the fall, but not in the winter time, during the coldest time of the year, because if you have very cold air with maybe only ten grains of moisture going into the machine and you are pulling back to the package a certain grain of moisture, you only have a pickup capacity of ten grains for the dunnage, and that has to be removed. Therefore, if you do it when you have more machine capacity and more pick up capacity, with warmer air, you pull down faster. Thank you.

COLONEL COOK: One other thing you might be interested in, in supplementing Dr. Queer's statement about the "balance wheel" of the dunnage on the interior of the package--we put this roof on the top to support the cocoon, because we didn't want any sharp edges or angles, and we were able to maintain a very even relative humidity line, even though we had 20 and 30 per cent fluctuations of temperature on the outside. We have had these stored at Charleston, South Carolina, and as you know, the humidity is very high there. As some of you Ordnance gentlemen know, we are very near the paper mill there. We had some very bad acid conditions there too. But they were stored, and that wooden content did equalize the line. We had a very straight line and maintained it between 30 and 35 per cent, maintained it in spite of the varied fluctuation in temperature.

MR. HIGGS: Are there any further questions? We have run out time out, about four minutes over, so I will adjourn the Pannel Session.

Thank you all for your kind attention. I hope we have been of help to you.

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Afternoon Panel Session

Wednesday, October 12, 1955

B1. Research and Development
Chairman, Dr. Hayward R. Baker
Head, Corrosion Inhibition Section
Naval Research Laboratory

Current unclassified packaging and materials handling projects and areas in which further study is desired.

Wednesday PM Oct. 12, 1955

Research and Development Panel

Dr. Hayward R. Baker, Head
Corrosion Inhibition Section, Naval Research Laboratory

During the last 15 years both industry and government agencies have made important advances in the packaging of equipment and supplies for shipment and for prolonged storage. Much of this progress has been accomplished through the cooperative efforts of industry and the military services. The storage and movement of great quantities of supplies during wartime emergencies necessitated the establishment of many research and development contracts pertaining to packaging materials. Some of the problems encountered in the earlier days have been solved; others are now being cared for by tentative methods; many are being investigated at the present time and many others probably exist which deserve immediate emphasis.

Improvement of any of the existing packaging procedures is desirable, but new projects should also be established to collect fundamental data which could be used to develop packaging materials of quality superior to any now in use. For example, emphasis should be placed upon the development of a material that could be used as an outer wrap for supplies subjected to tropical storage environments. This material must be resistant to the corrosive attack of the elements as well as the attack of insects and fungus.

Too much emphasis cannot be placed on the points which Admiral Furth brought out in his address on the first day of the symposium. To one in particular I would like to call your attention. Equipment, whether it be guns or bearings, that is meant to be used in the field of operation should be packaged ready for use upon opening. Spare parts for machinery should be packaged where possible in individual units to prevent waste. The time is past for using one bearing out of a package of a dozen and discarding the others or trying to repackage them for use at a later date. These component parts should be ready for assembly upon opening the package and should not require special cleaning or lubrication before assembly. To make this possible, packaging materials not affected by synthetic fluids and greases should be adopted and put to use without delay.

It is the responsibility of the military services to see that the equipment needed in military operations be packaged so that it may be transported and put into service in any

location on the globe. The methods of packaging must be economical but efficient. We can no longer take chances that vital equipment may reach far away bases in unusable condition. This task can be accomplished through effective research and development on packaging materials and methods coupled with rigid specifications to ensure that these packaging standards are met. It is also important that emphasis be placed on new types of materials the basic components of which will not become scarce during wartime. It is hoped that the session this afternoon will serve to establish some of the packaging needs upon which special emphasis should be placed.

We are going to present today in condensed form the projects and tasks pertaining to packaging now under study by the military either in their own laboratories or under contract with other laboratories. We shall have three speakers, one each for the Air Force, the Army, and the Navy. Since work on material handling is being presented in several of the other technical conferences now in session, this meeting will be concerned mainly with packaging projects.

Wednesday PM Oct. 12, 1955

Research and Development Packaging Program of the Army

Mr. A. V. Grundy
Director, Container Laboratories
of the Quartermaster Corps
Food and Container Institute, Chicago, Illinois

Before I start on this presentation of the Research & Development Packaging Program of the Army, I would like to bring to your attention the fact that this covers 7 Branches of the Service -- The Quartermaster Corps, The Corps of Engineers, The Ordnance Corps, The Signal Corps, The Medical Corps, The Chemical Corps and The Transportation Corps. It will be impossible in the time allotted me -- 30 to 35 minutes -- to present an over-all program of the Research & Development Packaging activities of those 7 Branches of the Service. For that reason, the Army has specifically chosen four of these Services for me to present to you and to give you the highlights of their Research & Development Packaging Programs for your consideration and your assistance in carrying out this work.

The four Services are: The Quartermaster Corps, The Corps of Engineers, The Ordnance Corps, and The Chemical Corps.

In the case of the Quartermaster Corps, the Research & Development activities are in the field of preservation, packaging and packing of Quartermaster items of supply, such as rations, clothing, chemicals, equipage and mobile units and machinery involving the research required to solve basic problems in packaging. This also includes the development of test methods for the evaluation of container performance under military supply line hazards; the design of containers to meet the requirements of military operations for both zone of interior or overseas destinations; and to devise special packaging and preservation techniques to assure protection of the contents of containers against deterioration and damage when shipped, stored, and handled under diverse environmental and climatic extremes.

The following examples of areas of investigation in the packaging fields will serve to amplify and further illustrate the scope of packaging and packing research and development activities presently being undertaken by the Quartermaster Corps:

The first one - "Investigation and Technological Studies Required for the Establishment of Test Methods, Design Techniques, and Performance Standards for Containers, Packaging Materials, and Components."

This involves internal and external research activities on a cooperative basis with the Corps of Engineers for the development of devices for measuring and recording shocks in containers and contents during handling and transportation operations in order to accumulate data for use in design of containers, internal blocking and bracing, and cushioning. This also includes investigations, of commercially available instruments for measuring shocks in containers and contents during handling and transportation operations.

In addition, the Quartermaster Corps is investigating shock-recording devices for aerial-delivery packaging systems. It is planned that such a recorder would show the number, magnitude, and direction of impacts to which shipping containers and contents on aerial-delivery platforms are subjected when delivered by air drop.

Industry survey has indicated that commercially available instruments do not meet the requirements for these important studies; therefore, research contracts have been let to design, develop, fabricate, and deliver such a shock-measuring and recording device.

Second - "The establishment of Performance Standards for Containers in Terms of Laboratory Testing Methods."

An investigation of the performance of standard containers under field conditions serves to determine those containers meeting minimum satisfactory performance levels for use as laboratory test standards. These investigations include the performance levels for multiwall shipping sacks, V-board fiberboard boxes of the standard type and the newly designed diagonally slotted type, wood, wood-cleated, and paper-overlaid veneer fabricated containers. The over-all investigation is progressive towards the reduction in tare weight and cube to achieve economical shipping containers to meet the performance levels in the military supply line.

Cooperation in these investigations is maintained with industry and leading technologists in the testing and evaluation field, mainly by Quartermaster Corps representation on ASTM-D-10 Committees.

Third - "The Study of New Structural Principles and Techniques for Container Design and Construction."

The University of Texas is conducting intensive research and development in the design methods for wooden containers to insure more balanced and economical construction. The Forest Products Laboratory is engaged in the establishment of a series of "units" and "constants" based on physical properties of fiberboard components that can be used (together with geometrical and design characteristics of containers and environmental data) to compute stacking strength of fabricated fiberboard containers.

Fourth - "Adaptation and Development of Containers for Cloth, Non-Compressible Clothing, Footwear, and Equipage Items, that will Preclude Scuffing, Wrinkling, and Damage by Microbiological Organisms."

In addition to the modification of design of the containers and application of container components for these items, the replacement of wooden containers with fiberboard containers with suitable inner packing to reinforce the containers and provide stability and requisite performance has been carried out with resultant savings in cost and reduction in tare weight and cube. This is a continuing investigation in order that the Quartermaster Corps may have lightweight, durable-type shipping containers and packs that will meet the objective of greater utility in highly mobile tactical warfare.

Fifth - "The Vacuum Packing of Clothing and Related Items."

A study is in progress of the basic factors involved in developing a container and methods for the packing of items such as sleeping bags, clothing, and related items, utilizing a flexible barrier that will retain a vacuum for an extended period of time under extreme changes of temperature and humidity coupled with rough-handling hazards.

Extensive reduction in tare weight and cube can be accomplished by the vacuum-packing method of suitable items which lend themselves to compression. The success of this investigation depends greatly upon the availability of reinforced moisture vaporproof and water-resistant barrier materials which can be hermetically sealed, to retain prolonged vacuum and resist shock impacts, both during fabrication and in transit.

A planned research contract to develop the facilities, methods and materials to achieve the over-all objective, is presently under consideration with various industrial and independent research organizations.

Sixth - "Development of Containers for Chemical Items of Hazardous, Dangerous, and Hydroscopic Nature."

The investigations by the Quartermaster Corps are primarily for those chemical items which fall under the jurisdiction of the Corps. Studies in this area are accomplished by cooperation with the Chemical Corps so that duplication of effort is eliminated. The essential work involved is to replace heavy glass or metal containers with plastic containers which will resist breakage to a maximum degree and be inert to the specific chemical products. Various approaches are under way with regard to strip-packaging of tablets, and the use of polyethylene and polyester-fiberglass containers for the packing of specific hazardous and dangerous products which deteriorate rapidly due to their deleterious effect on the presently used containers. The replacement with lighter weight containers should serve to reduce the excessive tare weight and cube.

Seventh - "Simplification and Modification of Demountable Features for Open Crate and Sheathed Containers to facilitate opening and reclosing for Maintenance and Surveillance Inspection."

The objectives of this investigation is to reduce tare weight and cube, and to conserve materials for internal blocking, bracing and packing of heavy-duty mechanical equipment. The development in this field is to promote economy by reduction in labor, operations, maintenance and servicing of the equipment without the necessity of dismantling and rebuilding the internal blocking and bracing of the exterior container. This embraces both the design and fabrication of both demountable and reusable containers of wood and metal. Industrial cooperation has been achieved with wooden and metal container manufacturers and manufacturers of the mechanical equipment. Planned contracts are being promulgated to standardize reusable metal containers for the shipment of major engine assemblies in the Quartermaster Supply system.

Eighth - "Studies and Investigations of Critical Factors Involved in Packing Foods."

This investigation involves the development and redesign of containers and packaging techniques for dehydrated and other dry items. The application of in-package desiccation is one of the major factors in new packaging techniques coupled with the bulk shipment of dehydrated foods in flexible containers. The latter phase has been given high priority in order to achieve lightweight packages and shipping containers for delivery by all modes of transportation, specifically for air drop, in the new concept of maintaining supplies during highly mobile warfare. This is also required to meet the advanced planning in simplified food logistics in packaging prepared dehydrated items or meals for rapid preparation in the field. This is comparatively a new task and will require considerable industrial assistance and cooperation in obtaining suitable, flexible, barrier materials and other components as the dehydrated-food program progresses.

An investigation is under study of the feasibility of dielectrically processing meat items in a container and the development of a suitable container for this type or processing. This investigation is to provide a packaged boned sterile ham or meat items similar in quality to refrigerated meats, so that refrigeration would essentially not be required in storage and transit. A contract has been in effect with the American Meat Institute Foundation to determine the processing techniques as well as the materials and containers that can be successfully employed in this specialized processing and packing technique.

Ninth - "Study of the Most Practical and Economical Technique for the Preparation of Unitized Loads of Subsistence".

Investigation of methods of unit loading by industry, the Army, the Navy, and the Air Force is required to determine the feasibility of unit loading in the shipment of subsistence items for both domestic and overseas destinations. This study will include currently used methods. Past experience or progression made by industry in palletized loads will be utilized. This investigation is to embrace past industrial and military experience in order to obtain the most efficient and economical methods, pallets and containers suitable for both land and sea and specifically for air transportation.

Tenth - "Packaging for Radiation Sterilization."

Studies are necessary to determine the effects of high-energy radiation on the physical properties of containers in order to assure adequate protection of subsistence sterilized by the radiation process. Investigations covering the

changes in sealing compounds in metal cans are already under-way way. The improvement of container properties through exposure to high-energy radiation is also contemplated.

Those are the major items of the Research and Development Packaging Program in regards to the Quartermaster Corps.

We now turn to the Engineers. Specifically this program emanates from the Packaging and Packing Laboratory, Engineer R&D Laboratories, at Fort Belvoir, Virginia.

With the end of World War II and the resulting slackening of procurement pressures for hurried packaging requirements, the packaging development program entered a "refinement phase." With the recognition that many wartime packaging requirements were overdone or fast becoming outmoded, work on new or improved methods, materials, and techniques was begun. Of utmost importance in this phase of the program was to attain the greatest economy in packaging both from the monetary standpoint and that of minimizing the drain on critical natural resources, consistent always, however, with requirements for adequate protection of material. It was at this time that the packaging laboratory was established at Ft. Belvoir and projects were authorized to permit extensive testing and evaluation of packaging requirements. Authorization to investigate new materials, was also obtained and is maintained to this date. A new crate design was developed which required less lumber. New marking techniques were found which prolonged the life and improved the legibility of marking on containers stored in the open. By means of field and laboratory tests, many improved methods of preservation were found and better and more economic container applications. Mobile packaging equipment was developed which permits normal packaging operations to be carried out far from the established packaging lines of large depots or industrial plants at far flung points no matter how isolated they may be. Needless to say, throughout this phase a program of specifications preparation and maintenance was pursued so that as new methods, materials, applications, etc. were proved, they were soon adopted in the packaging or end item specification.

One of the most interesting projects pursued by the laboratory at Ft. Belvoir is that of Packaging Shock and Vibration Research. Pioneering in this field some years ago, their efforts to bring about sound engineering approaches to the design and application of materials, containers and devices to absorb the energies of impacts and vibrations encountered in shipping, have been largely responsible for the wide

recognition being given this field today. Two major problems have confronted the researchers in this field and are receiving considerable attention at this time. One is that of measuring and defining the shocks and vibrations encountered in handling and shipping, and the other is in defining or establishing the fragility of items to be shipped. The packaging laboratory at Ft. Belvoir is one of the best equipped facilities in the military establishment for measuring the shocks and vibrations in and on packages undergoing laboratory tests. However, this group was quick to recognize that the validity of laboratory tests would depend largely on correlation of the tests to actual field handling and shipping conditions. Thus began a search to find out what was known of actual field conditions. Through a series of contracts with a university and with private research organizations, it was pretty well established that very little was known in terms of engineering units that could be correlated with laboratory measurements. It was further found that the instruments needed to make and record accurate shock and vibration measurements over long shipping routes were not to be had. The next logical step being to develop such instruments, a development contract was awarded this summer. This step was of course preceded by feasibility studies. Once the instrument hurdle is crossed, there will follow a long period of field measurement work during which time data will be collected and digested through computers to arrive eventually at values which can be used both in package design and in establishing more realistic laboratory test procedures.

Considerable work has already been done and more is continuing in various laboratories on the physical characteristics of cushioning and packaging materials. This leaves us with the other major problem in this field, that of fragility. In other words, what can the various items stand in terms of shock and vibration without being damaged. Some work is being done in this field, but the surface has hardly been scratched. Here is a field in which industry can make a major contribution by determining the fragility of items produced and sold to the Military. The number of such items is astronomical; so you can see what we face in trying to do it alone.

We believe that this project holds great promise for the future of package design. Not only do we need more precise information to plug into design criteria for such things as guided missiles and delicate electronic gear, but the every day run-of-the-mill shipping container may be subject to considerable simplification and lightening with a closely calculated level of risk.

The packaging laboratory at Ft. Belvoir has several items of testing equipment which are unique in the packaging field. There is a 100-ton-capacity press which can apply top loads to crates up to 8 feet in width and 12 feet in height. There is a shock and vibration as well as strain-recording system which is multi-channel to the extent of 9 shock and vibration and 36 strain-recording channels. A railroad hump track extends into the laboratory building and is controlled from within the laboratory, permitting all-weather operations with extensive instrumentation. There is also the more standard equipment such as 14- and 7-foot revolving drums, various vibration tables, the Conbur water-submersion tank, a cleaning and preservation line, and various tools and machines for the fabrication of containers and packages. In close support of this laboratory and located in nearby buildings, are facilities for tropical as well as high- and low-temperature and altitude exposure, high-speed motion picture coverage; a complete machine shop, woodworking and model shop facilities and a materials laboratory. For long-term storage tests the packaging laboratory has access to field test stations maintained in the Arctic, the Tropics, the Desert, and several temperate-zone sites.

Other problems which are being given current attention by the Packaging Laboratory at Ft. Belvoir include a number of preservation problems arising from open storage of heavy equipment; the cleaning and rust removal problems; a study of the water-vapor transmission rates through certain types of containers; the cushioning effects of certain containers; improved chests for tool and equipment sets; the use of shrouding inside open crates, and the bundling with reinforced tape. In addition to their R&D work, this group is also active in packaging standardization work and devotes a considerable effort to this field.

Passing from the general categories of work under way, perhaps you would like to hear more about a few of the specific tasks in the current program.

"The Shock Recorder Development." As indicated earlier this is an attempt to develop an instrument which will produce accurate results in a form usable to the package designer. Having determined through contract studies that such an instrument was not available, another contract was awarded to a private research organization to determine generally what such an instrument should do and what types of systems might be employed in its make-up. This accomplished, the staff of the packaging laboratory made a feasibility study on the proposed systems, found them feasible, and proceeded to award a

contract for the instrument development. The instrument is to be capable of unattended operations for long periods, covering the duration of a cross-country shipment. It is to be shipped unpackaged, which means that its shipping container must be an integral part of the instrument and must not change its physical characteristics even after repeated impacts. This is to permit recording of all shocks uninhibited by ordinary shipping container materials. The recording medium will be sensitized film employing a principle of variable film density recording to minimize the amount of recording medium required. The record will be capable of being played through computer equipment for fast analysis. The range for the instrument is defined in terms of equivalent height of drop and nature of material struck.

"The Cushioning Value of the Container." This work is just starting in the laboratory, pending arrangement for suitable instruments to try to determine the characteristics of various standard types of shipping containers. Again, we are trying to get value in the form usable to the package designer.

"Improved Marking Materials." Sometime ago, an investigation was made into ways and means of improving the legibility and increasing the efficiency of the markings on shipping containers, which must be stored for long periods out-of-doors. This resulted in recommending an undercoat and an overcoat - then a sealer. First the marking is applied, next the overcoating of the protective material, and a varnish is applied last. At the same time, recommendations were made for the development of improved materials for the use of this method. Thus, we are investigating and eventually will test the most promising materials available from industry which will give us faster drying, longer life, and lower initial cost.

"Use of Reinforced Tape for Bundling." Lumber and steel, as you well know, will become critical items, and the use of steel has to be stricken. It seems probable that we can use reinforced crates in bundling certain types of commodities. The possibility seems ripe for it in such applications as we have in our consolidated set package.

"Improved Chests." Improvement of Engineer Chests for the Corps of Engineers for the many tools that are carried by the troops is under study. The chest is designed and equipped with many small slots to hold and protect the tools as the sets are transported to and from the job. In packaging these tools we must protect them for periods of long storage. We have found through experience in shipping these chests that

they also require mechanical protection. Thus, we have three primary objectives in trying to definitely improve these chests. We want to reduce the preservation cost, eliminate the extra box of tools, and eliminate the box around the chest. To accomplish these objectives, we are developing a chest that can be sealed and will have low enough water-vapor transmission characteristics to permit use of a desiccant inside the chest. This will eliminate the wraps, etc. from the tools in the chest, thus eliminating the extra box. The new chest is to be rugged enough to withstand shipment as well as field use, thus eliminating the need for the overboxing. We are working now on a reinforced plastic design and have a small contract out for development of prototypes.

These are but a few examples of some twenty or more tasks currently being pursued by the Packaging Development Group at the Engineer Laboratory, Ft. Belvoir, Virginia.

The Ordnance Corps are at present mainly concerned in Research of Packaging Materials though, of course, the protection of items and parts of Ordnance material against deterioration continues to be a major problem. During the World War II considerable materiel was received overseas in poor condition because of unsatisfactory packaging materials. Many failures can be traced directly to carelessness on the packaging lines where improper use of materials and other factors caused failures of packages that otherwise would have been received in usable condition.

In recent years more and more emphasis has been placed upon the importance of materials and packages which will provide adequate protection at very low temperatures. The aim of the military in regard to low temperature characteristics is to approach as nearly as possible the goal of having materials and equipment capable of operation at -65°F and able to withstand shipment and storage at -80°F.

In view of the above temperature requirements, it was apparent that many materials being used were inadequate. Recognizing the low temperature deficiencies of many packaging materials, the Ordnance Corps placed emphasis on research and development to achieve the desired characteristics.

Among the first packaging materials to receive serious attention were the JAN-P-125 waterproof barrier materials. This type is used in case liners for exterior shipping containers as in the packaging of hardware items and for tarpaulins for temporary outdoor storage of items in forward areas. This material is essentially an asphalt-kraft-paper

laminant, has notoriously poor low temperature characteristics and, therefore, is not suitable for Arctic use. Consequently, development and evaluation effort was concentrated upon laminates which do not contain asphalt. Polyethylene appeared to be the most promising of all materials; hence most development effort was concentrated upon that plastic. As a result of this work, with considerable assistance from Industry, Specification MIL-B-13239(Ord) was prepared and promulgated. Since this is a recent development, the materials have had only limited use, but already have demonstrated their superiority over the asphalt-kraft-paper laminates. This plastic material is expected to show superiority in resistance to fungus deterioration and greater flexibility as well as better waterproof protection. While possessing greater flexibility, the polyethylene barrier material still falls short of all the desired characteristics at -65°F. It is, therefore, necessary that research and development continue in an effort to obtain a waterproof barrier material that will give complete protection in both Arctic and Tropic regions. It is hoped that Industry will continue its interest in developing such material and will supply samples of products they believe to be superior and thus contribute to attainment of our objectives.

One of the most widely used packaging materials is the hot-dip, strippable plastic film procured under Specification JAN-C-149. Two types of material are prescribed by this specification. Type I is ethylcellulose and Type II is cellulose acetate butyrate. Type II is now more frequently used because it has proved to be more stable in storage and is a clear product, permitting labels to be read through the film. However, this material has been unsatisfactory because of its low-temperature characteristics. At temperatures of zero and slightly above, it cannot be stripped satisfactorily and will shatter if the package or coated part is dropped. Often this results in damage to the part the film was supposed to protect. This has been one of the most difficult problems in the low-temperature field. Extensive research, by an Ordnance Laboratory in cooperation with interested industrial firms has produced a material that will strip easily and not shatter at temperatures somewhat below -40°F. Outdoor weathering tests are being correlated with laboratory tests to provide realistic requirements that will enable the government to procure satisfactory materials with a minimum of acceptance testing. Here again, the optimum material has not been obtained, but through cooperation with Industry, a great improvement has been made.

One of the more widely used materials for the preservation of material is vinyl, sprayable, strippable-type barrier. This material is used for interim preservation and storage of vehicles, gun mounts, and other material. Materials of this type in the past have proved rather unsatisfactory because they provided too short a weathering life, they have a high plasticizer migration rate, fail to protect rubber items such as tires and possess unreliable adhesion characteristics. A new revision of Specification MIL-B-12121 has recently been issued, and it is believed that most, if not all, of the above deficiencies have been overcome. Tires will not continue to present a problem since tires now being manufactured contain an anti-oxidant agent, making surface protection unnecessary. The methods of vehicles preservation are still far from perfect and leave an important field in which the Ordnance Corps needs the cooperation of Industry to work out better solutions for standby and extended storage.

Another material that has been the object of much research and development is a product that will serve the same purpose as the hot-dip, strippable compound but will be capable of being applied at room temperature. Some success has been attained to date, but the material is deficient in that insufficient film thickness is obtained in one dip and solvent release is too slow for fast packaging operations. However, this material has been developed to a point where it has practical applications, and is currently being used as a protective coating and cushioning material for lenses, prisms, and for fire-control instruments. A better material that can be used as a dipping film at room temperature and an easily removable strippable film at wide variance of temperatures is desirable.

Some additional Ordnance research tasks of interest are as follows:

Studies are continuing to determine the relationship of water-vapor transmission rate (WVTR) of flexible water vaporproof barrier materials to the rate of corrosion which occurs to surfaces susceptible to corrosion. Results of this study will be used as a basis for establishment of the degree of water-vaporproofness a package must possess in order to prevent corrosion of packaged parts. Successful completion of this program will provide a valuable tool whereby a packaging engineer will be able to select the most economical and efficient barrier material for the item being packaged and thus prevent "overpackaging".

Aging characteristics of various types of barrier materials used by ordnance are being studied. They are being exposed to outdoor and indoor storage conditions to study the improvement of their aging resistance.

A long term study is under way to determine the compatibility of JAN-P-117 bag material (used for packaging of spare parts, etc.) with VCI material (vapor corrosion inhibitor). Moisture vapor transmission rate determinations of bag material in contact with VCI material are being made after indoor and outdoor shelf aging for fixed periods of time.

The barrier materials research program for storage of machine tools is continuing in order to find materials offering improved protection for long-term storage. Samples of asphalt-vinyl and asphalt-rubber coated screen wire are being evaluated for water vapor transmission rate.

Those are the main highlights of the Ordnance Corps in the Research & Development field of Preservation, Packing, Marking and Packaging.

The objectives of the Chemical Corps packaging program are the same objectives as those of the Department of Defense. However, they are particularly related to military materiel of the Chemical Corps. These objectives are, first, designing, developing, and development testing of adequate preservation, packaging and packing for Chemical Corps materiel. Second, insuring that the preservation, packaging and packing developed is suitable for production and that standard components, materials and procedures are utilized to the maximum extent practicable to obtain adequate protection at minimum cost. Third, developing and providing engineering information upon which to base the preparation of packaging requirements for specifications and drawings.

These objectives are accomplished within the Chemical Corps by a packaging unit located at the principal developing activity, Chemical Corps, Chemical and Radiological Laboratories, Army Chemical Center, Maryland. Here, packaging and packing design is considered concurrently with a specific item design in order that maximum economies may be derived by elimination of difficult packaging requirements early in the basic design of the item.

To illustrate the particular type of packaging problems which the Chemical Corps is concerned with, some of the board areas of packaging development are presented.

First of all, we are concerned with the "Packaging of Fuel Thickeners".

The present procedure of bulk packing of Napalm and other fuel thickeners utilized in fire bombs and flame throwers have not proved entirely satisfactory. The material is packaged at the present time in metal containers arranging in volumetric capacity from 2 to 30 gallons. In tactical use, small quantities of the material are removed and if the material is not properly resealed, the remainder will absorb moisture and be rendered unsatisfactory for use. The particular problem in packaging here is the unit packaging of a predetermined weight for mixing a batch of given size. It is desirable that this quantity of material be withdrawn from a bulk container, the container resealed, and the remainder of the material within the container be capable of indefinite storage under adverse climatic conditions. To date, several types of unit packaging have been investigated. None of these are completely satisfactory. The containers investigated include metal drums and fiber drums with a number of unit containers packaged therein. These unit containers consisted of fiber tubes, multiwall shipping sacks, and other types of interior containers that lend themselves to nesting. Various types of moisture vaporproof ckaging materials have been utilized to gain the moisture protection required. However, due to the nature of the material being packaged, sealing of these barrier materials have not been satisfactory. Reinforced fiberboard containers are currently under study. Also various novel methods of sealing flexible barrier materials are being evaluated for their efficiency. Various industrial concerns have been most cooperative in participating in this program and their support is continuing in that new materials and containers are being constantly submitted for evaluation to determine whether they are the answer to this particular problem.

The second item is "Fiber Drums for Chemicals and Hardware".

The Chemical Corps has been assigned the procurement responsibility for the purchase of many chemicals. Packaging requirements for many of these chemicals are very indefinite and actually are of little assistance to the manufacturer furnishing the material for military requirements. Fiber drums are one of the most desirable means of packing chemical products inasmuch as they are relatively corrosion free, not fragile like glass, and in most instances less costly than other methods of packaging chemicals. They are considered a material container for packaging of chemical products. Specialized interior coatings are required in some instances

to passivate the chemical contacting the container wall. A continuing need within the Corps exists for new and improved types of fiber containers with superior storage life. As a result of the experience with fiber drums and the packaging of chemicals, these containers have in recent years been designed and tailored for many items of hardware. These designs have been most successful. At the present time a particular problem exists for the development of a low-cost fiber drum for the packaging of fire bombs. The fiber drum industry has been most cooperative and have furnished freely of their talent and skill in participating in the development of these containers.

The third item is "Faceforms for Gas Masks".

Most individuals associate the Chemical Corps with the gas mask. The gas mask undoubtedly is one of the Corps' most important products. Even this item has its packaging problems. The facepiece is molded from rubber. To maintain this rubber facepiece in a satisfactory shape and condition in storage it is necessary to use a packaging aid which we designate as a faceform. The most successful faceform for many years has been a fabricated fiberboard unit. The various pieces of the faceform are die cut and stapled by hand. It is the desire of the Chemical Corps to obtain either a molded-paper, plastic, or metal faceform that will be less costly than the present one. Effort to date has been the investigation of two different plastic types and also a molded-paper type. The plastic types in their present design and configuration and material cost are not practicable. The molded paper is currently under development. Factors in the development are water resistance, toxicity, and compatibility with rubber.

Industry has, and is participating in this development. However, it would be desirable to have more types of Industry participating in this program.

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Research and Development Packaging Program of the Air Force

Mr. M. E. Bowman
Wright Air Development Center
Wright-Patterson Air Force Base

The Packaging Section of the Materials Laboratory at Wright Air Development Center, of which I am a member, is responsible for research and development in the field of packaging, and for standardization of materials, procedures, and methods; the use of preservatives; containers with particular emphasis on lightweight containers; and packaging devices such as humidity indicators.

We also prepare those packaging specifications which are delegated to the Air Force by the Department of Defense and coordinate on packaging specifications prepared by other services. We coordinate on the Packaging Section of each Air Force commodity specification.

The aim of our Research and Development, the ultimate outcome, is the preparation and coordination of these specifications and assistance to the Air Materiel Command in the preparation of technical orders in the field.

I shall not deal with materials handling. As you probably are all well aware, materials handling is a function of the Materials Handling Branch, Transportation and Packaging Division, Air Materiel Command and the Equipment Laboratory, Wright Air Development Center.

We are concerned with the broad field of packaging which we subdivide into more limited fields such as shock absorption, containers, devices that I mentioned before, and the various packaging materials. I shall mention some of these that we are working on now, and outline the objective and requirement for these subdivisions of the broader field, which are known as "sub-tasks". The first one I shall speak about is the "Investigation of Preservation Methods for Complete Aircraft Shipped Deck-Loaded."

The present methods used in preparation of complete aircraft for deck-loaded shipment, utilize a strippable plastic material. In the past, contact preservers had been used. I understand they are now coming into use again. These methods have required, to some extent the replacement of parts, that is, disassembly to some extent of the aircraft.

Aircraft are presently prepared for deck shipment by use of strippable plastic coating. The faults involved in this method are as follows: Difficulty in application of the coating, variable moisture transmission rates due to uneven application of the material, necessity of removing exterior aircraft components to accommodate the coating, and of providing extra protection to prevent damage to painted areas and plastic parts. Daily inspection and frequent repair of coating during shipment is necessary.

One of the drawbacks of the contact preservative method is that contact preventatives, as experienced in the past, are difficult to remove.

The proposed solution for this sub-task is to develop a nonreusable polyethylene envelope which would enclose the complete aircraft, thereby eliminating the need for strippable coating. The initial cost of polyethylene is lower, the application technique would be simpler, a lower, uniform, rate of moisture vapor transmission would be established, the removal of exterior aircraft components could be reduced or eliminated, and the removed envelopes might be used as covers or shrouds for items in temporary outdoor storage at overseas destinations. We are going to let a contract to design and manufacture envelopes for service testing. One of the most important factors for the success of this project is the availability of an efficient heat sealer. Currently, available portable heat sealers have difficulty in effecting a seal when sharp angles and curves are involved. Difficulty has been experienced in previous tests of polyethylene envelopes from chafing of aircraft skin by the envelope. This condition was caused by movement of excess envelope material by wind and ship motion. A snug fitting envelope is necessary.

Another sub-task, is "Investigation of Sprayable, Strippable, Plastic Coating Applications and Methods".

The objective of this work is to extend the use of strippable coatings when advantageous and to study the present methods and techniques of application so they may be improved to the highest degree of efficiency.

The Air Force has confined strip-coat protection principally to the preservation of complete aircraft and vehicles. A thorough review of Air Force items which could be safely and economically protected with strippable coatings has never been accomplished. The presently used

application techniques do not assure an even thickness film. This results in thick areas which waste material and thin spots which allow intress of moisture vapor. Poor application technique results in porous films lacking sufficient tensile strength and elongation, especially upon aging. Since the aircraft are not generally painted, splitting of thin areas upon aging is especially serious in salt atmosphere. To overcome these deficiencies, a hot-spray technique is being investigated. It should be noted that new coating materials are also being evaluated in the effort to provide more efficient application techniques and more efficient coatings. Information concerning use of hot spray in the application of high solid vinyl spray coatings, 30% solid or above, is desired. Coatings meeting the present performance requirements of Specification MIL-S-8141 and compatible with painted and nonmetallic surfaces such as plastics and rubbers are desired.

Solvent barriers now in use between painted surfaces and coatings are water soluble, causing loss of adhesion and requiring excessive drying time when applied under high-humidity conditions. Solvent barriers having the same adhesion as the protective overcoating and capable of being stripped simultaneously with the outer coating would provide an excellent advance over present practice as an interim measure until compatible coatings are available.

Another of our sub-tasks is "Investigation of Cold-Dip Strippable Plastic Coating."

The present hot-dip plastic material used in conjunction with Specification MIL-P-116, Method IB preservation, involves the use of heating tanks and rigid temperature control. Material is frequently wasted because of degradation. The coating is opaque when dry, necessitating removal of the coating for inspection. Owing to the relatively high moisture vapor transmission of the material, a thick coating is required. For these reasons, hot-dip plastic materials are costly to use. A cold-dip, clear material would increase efficiency of operation, probably reduce material and application costs, remove personnel hazards, and could expand the use of Method IB to items damageable by high temperature.

Available possible materials for this application are being investigated. The Air Force is receptive to testing and considering materials developed by industry. Material should have a moisture vapor transmission rate as low or lower than a 50-mil CAB film for 20-mil film, be transparent

to allow inspection without removal of coating, be capable of being applied with one dip operation, incorporate a corrosion-inhibited oil, and be easily and completely removable. The Air Force is also interested in learning of any possible instances where cold-dip materials are being used in a manner which could be advantageously adopted.

Another field of research and development in our shop is "Field Handling and Transportation Conditions."

Work was initiated in 1954 for the investigation of service conditions. The project is aimed primarily at gathering field data on rough-handling conditions in the shipment and transportation of military supplies. Data will be treated statistically and will be used to set up more realistic laboratory drop- and rough-handling testing procedures. This can mean significant savings to the Air Force in both the protection of lading from damage and the elimination of overpacking.

The service conditions data could be obtained by the following methods:

1. Personal observation at depots and ports.
2. Concealing impact-recording instruments in ordinary shipping containers and shipment of the instrumented packs to overseas destinations.

We have chosen the latter method in our work. This method seems ideal since it eliminates the preferred handling which occurs in the presence of observers.

Five impact recording devices are being evaluated. These recorders contain three mass-spring components set at right angles to each other with an inertial switch that indexes the recording tape on each successive impact over 5 g's. Calibration of the recorders within the container is now in progress.

If this approach to the problem is found to be satisfactory through laboratory tests, 50 recorders will be ordered. Air Materiel Command will monitor shipments to overseas destinations. Shipments are predicted to start this spring and will cover a 20-month period. Air shipment will be investigated initially. Different types and weights of containers will be shipped. Selection of overseas destinations will be on a random basis.

Another sub-task deals with, "Fiberglass Containers".

Fiberglass from a standpoint of thermal structural properties and high environmental resistance, is materially suitable for possible application as a shipping container. Comparative data on long-term storage characteristics are not yet available. The objective of this project is to investigate the physical properties of fiberglass and to develop, test, and standardize the use of fiberglass as a shipping container media. Containers to be studied will be constructed similar in design to metal containers now in use for helicopter rotor blades and jet engines. Long-term storage, handling, and shipping data will be obtained and evaluated.

Fiberglass containers and metal containers will be stored at sites in Southern Florida, Alaska, New Mexico, and Wright-Patterson Air Force Base, Ohio. No information has been recorded either by the industry or by Armed Forces on this type of test. Contracts for 104 each H21 helicopter rotor blade fiberglass containers and 104 each J-57 jet engine fiberglass containers are to be let. One hundred of each type container will be field-tested under actual use conditions. Four of each type containers will be outdoor tested, one of each type at each of the four sites mentioned. Metal containers will be used as controls for this test. A material process study of laminates, resins, fillers, molding time, and pressure will be made to determine the best materials for large size military containers. It is hoped that by this effort many of the doubts concerning large fiberglass containers can be removed, doubts arising from lack of storage and handling data.

Another sub-task deals with, "Polyethylene Containers".

Polyethylene containers, from a standpoint of sturdiness and comparative chemical inertness, could find many uses in Air Force packaging both for air and surface transportation. At the time of the initiation of this project, December, 1951, little data was available on the compatibility and permeability rates of various chemicals in polyethylene containers under long-term storage conditions. Approximately 80 chemicals, representative of most classes and subclasses of chemicals, were evaluated as to compatibility and permeability in polyethylene containers. The mechanism of transfer through polyethylene, permeability rates, and a mechanical method of calculating shelf life of any given chemical were determined. This work has now been completed for the polyethylene formulations selected for testing, including bottles irradiated with neuclear energy. The data is presented in WADC Technical

Report 53-133, Parts I, II, and III. Part I of this report is now available through the Office of Technical Service, Department of Commerce. The other parts of the report will be available through The Department of Commerce in the near future. This project has aided the Air Force in release of Specification MIL-C-26701 (USAF) entitled "Containers, Polyethylene, Flexible, Plastic."

As new polyethylene formulations to reduce permeability and enhance compatibility are introduced by industry, it will be necessary for the Military Services to be kept informed and to revise procurement specifications and use procedures accordingly to take advantage of improved products. Savings have now been realized by shipment of battery acid in polyethylene containers. This is especially true for shipment by air where the polyethylene container replaces glass containers, absorbent dunnage, and overpacking. Through research with plastic containers savings can be realized by reductions in weight, cubage, and handling charges. We are now investigating the use of polyethylene containers as a possible substitute for small metal reusable containers such as AN cans.

The next sub-task deals with the "Howe Twist Lock Container". The twist lock container, developed by Mr. Herbert Howe has been under investigation by the Air Force for more than a year.

A need exists for a more efficient and simpler closure for Specification MIL-C-6054, "Containers, Shipping, Exterior, Reusable," containers so extensively used in Air Force and Military packaging. A container incorporating only three parts - body, top, and gasket — was evaluated. The container lid and body have interlocking threads. Evaluation consisted of preliminary laboratory tests for rough handling and airtightness and an extensive field evaluation that involved shipment of 50 containers to each of eight stateside Air Force Depots and an European Depot. This report is now being written and will be released as WADC Technical Report 55-64. The containers were well accepted by Depot personnel who appreciated the ease of handling feature of the new closure. The containers can be closed in 27 seconds by use of a simple attachment on a pneumatic gun or can be easily closed or opened with hammer and block. The Air Force has approved the use of this container and is requesting a project for the revision of MIL-C-6054 to include the new closure feature. The Air Force has a continuing requirement for simpler and more efficient container closures.

The next sub-task deals with "Humidity Sensing and Recording Devices".

A need exists for more accurate and simplified methods for measuring and indicating relative humidity within sealed containers. The desired item is a simple, accurate, and reliable means of sensing and indicating or recording the humidity conditions within sealed packages. The information furnished by the device should be available upon inspection without opening or damaging the package. Reliable operation over the range of temperatures encountered in storage, and operation for lengthy storage periods, is necessary.

Electrical humidity-sensing devices are being evaluated by the Signal Corps. The Air Force has evaluated chemical-type, color-change indicators which incorporate the indicators covered by MS 2003, the 3-spot color change indicator card, and MS 20025, the one spot card, now in Military use. These humidity indicators can be positioned on the external surface of metal cans or on the external surface of MIL-B-131 barrier material packs.

From the data and experience gained from our investigation proposed specification MIL-I-26860 (USAF) has been prepared and is now being coordinated with the indicator industry. Meanwhile the Navy is preparing a specification for the color-change card now covered only by drawings. The specification, when released, will provide for better control over the indicating spot used in the color-change, surface-mounted type indicator.

The next sub-task is "Performance Evaluation of Cushioning Material".

This research is directed towards eliminating guess work in the practical application of cushioning materials to specific packaging problems. Stress-strain data is being collected on some 50 different commercially available cushioning materials. The relationship between static and dynamic loading is being investigated. As an outgrowth of static investigations, a general cushioning specification, MIL-C-2681 (USAF), has been written based on performance ability of material rather than on type of material. Proposed specification MIL-C-2681 is now in the process of coordination. A dynamic tester is in operation on this work. Industry can continue to be of help on test methods, test data, and instrumentation. The over-all product of this project will be a use manual based on dynamic information.

The last sub-task I shall mention is one that is in the very initial stages, "Investigation of Materials, Techniques, and Apparatus for Foaming In-Place Plastic Cushioning, Blocking, and Bracing".

It is anticipated that our efforts will lead to materials for use in situations requiring both resilient and rigid materials. A successful outcome of this project, we feel will be a tremendous step forward in the Air Force Packaging Program's over-all objective of providing more Air Force per dollar.

I have said that the Air Force Packaging Research Development Facility is at Wright Air Development Center. Our symbol or Code for mailing purposes is WCRTH-5. Our broad areas of research and development cover cushioning, containers, preservatives and packaging materials. I have detailed the objectives and requirements for some of our sub-tasks under these broad fields.

I stated that our primary objective, in common with the other Air Force efforts, is the attainment of more Air Force per dollar. It is also in common with the objective of the other military agencies and of industry working in the packaging field, which can perhaps be covered more broadly by the term "more defense per dollar".

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Research and Development Packaging Program of the Navy

Mr. Samuel Schwartz
Bureau of Ships, Navy Department, Washington, D.C.

When I learned I was to be last speaker on this Panel, I wasn't particularly happy -- I didn't jump for joy. I felt I had been beaten to the punch, and what I would have to say would be pretty much, "ditto".

It is true we all have essentially the same problems, that of protecting and preserving military supplies for long-term storage and universal handling. We, in the Navy, feel that we have one additional responsibility, at least -- that of replenishment at sea, which you have heard so much about at this meeting.

We have a motto in the Navy which describes our prime objective, even in packaging. That motto is "Service of the Fleet". I think the Army has a motto that goes "The Man Behind the Gun". That is what we are trying to do in all our work. We are trying to provide the wherewithal to get the item, whatever it may be, out to him in as nearly ready-for-use condition as we can possibly make it. That means at the end of the line the part or equipment should be available for use with a minimum of preparation. There are so many things that take place between the fabrication of the item and its delivery to the end user. We want him, the user, to be able to take the item out of the package and operate it with a minimum of depreservation, whatever the item happens to be; whether it be an electronic transmitter, a weapon, or what-have you. I think that is something we should keep in mind.

We are conducting research in the development and application of "Contact Preservatives". We have a need for thin-film, water-displacement compounds, which, after years of effective protection, can be readily removed, or not require removal by virtue of possessing and retaining lubricating properties. Such a compound would be useful, for example, in machine tool preservation. If we can accomplish all that, we shall have answered a lot of our basic problems. The less we have to remove, the better it is for the user at the end of the line.

The Bureau of Aeronautics has developed a thixotropic preservative for preservation of reciprocating engines that remains firmly in place on the surface without the drain-off associated with oil-type preservatives. This material,

specifically, was developed in their field to solve a number of problems that were inherent in materials available up until that time for aircraft piston-engine preservation. Preservative material, available at the time, were heavy oil types which drained off surfaces, exposing them to subsequent corrosion. The solvent cut-back type materials developed later were objectionable, in that they required removal prior to activation of the engine. The Bureau of Aeronautics has developed a preservative material having thixotropic characteristics. After hot application, the compound sets on the metal surfaces of the cylinder walls, does not drain off during storage exposures, and need not be removed prior to operation of the engine. The Bureau of Aeronautics has had successful experience with the material in extensive service tests in such outlying areas as Hawaii, the Philippines, and Alaska under extreme weather conditions, as well as the United States. The Bureau of Ships and the Bureau of Yards and Docks are giving this material closer consideration for possible incorporation in the preservation of the internal combustion engines in our own systems.

We, of course, are continuing basic studies. The Office of Naval Research is sponsoring and supporting studies in areas such as the Prevention and Deterioration Center, and they are operating a number of exposure sites, too. We are interested in what causes materials to go bad, so that we can prevent it either by changing the basic materials or by the application of preservatives.

The strippable-coating procedure was mentioned earlier, and I thought I should get a plug in for a new material that seems to offer promise for complete aircraft preservation -- "Polyvinyl Acetal". It has shown great promise. The Bureau of Aeronautics has found that the pigmented material gave the best results. The material has been applied from a water dispersion; it has excellent weathering properties.

The other day there was a paper presented on TEFLON. I take this opportunity to call your attention to some of the highlights that have interested the Navy in its use. True, it is an expensive material at the moment, but with something under a mil-thick coating, we get long-term preservation as a bonus to its primary property of dry lubrication or boundary lubrication. There are well-defined limits to TEFLON'S application based on laboratory experience; a number of "gray" areas still need to be checked out. In the Bureau of Ships, we are setting up a program to extend the work that has already been done in the Bureau of Ordnance on guns, and in our Bureau in submarine periscope installations, to parts and components of internal combustion engines.

Mr. Samuel Schwartz Wednesday PM Oct. 12, 1955

One of the amazing things about the TEFLON material is that it is so reluctant to be contaminated that dirt doesn't stick to it. The stuff just doesn't like anything else, apparently. One of the primary deterrents to the universal use of such a remarkable material is the fact that the material requires high temperature cure, something about 700° F., and in that process many substrate materials won't take it. Mr. Fitzsimmons covered a wider area in his presentation.

The Navy is investigating the use of solar energy for dehumidification. Do you know that the Navy has been one of the primary users of dehumidified storage in long-term storage of equipment and materials and is conducting a study of the effects of long-term dehumidified storage upon the various materials and methods of preservation that have been utilized. There is a concurrent program in the investigation of the need for providing controlled storage for Method II packs.

The Navy is looking for contact preservatives that can be used on mill runs of sheet aluminum steel so that the sheet will require no further processing for storage.

We are still looking for answers in coating of steel drums, just as is the Army, and there is a program underway at the Naval Laboratories to evaluate coatings for use in this area.

The Navy has other studies going on. We are using VCI (Vapor Corrosion Inhibitors) packaging materials. We have seen new methods of application. A formed-in-place material is being used in aircraft gas-turbine engine preservation. Two vapors are reacted to form a vapor corrosion inhibitor. Industry is developing volatile materials for the preservation of metals other than steel, and the ultimate is one material that would allow us to preserve a complex assembly of many different basic construction materials without adverse effects on any of them. We'd like also to see an indicator that would enable us to determine visually the condition of the volatile corrosion inhibitor in a package, and its suitability for further use.

A question arose in one of the panels this morning regarding the status of the desiccant specification, MIL-D-3464. The revision to MIL-D-3464, the packaging desiccant specification, is in the hands of the printer. It will have just one type of desiccant. There is, insofar as our own experience is concerned, just one material that's been

supplied under the current specification. The problem appears to be one of quality control. We are trying to be realistic about this specification. It has had wide circulation for comment.

In the field of protective packaging, we are studying cushions, isolators, and various suspension devices. The Naval Research Laboratory has recently published a Handbook on "Guided Missile Packaging" for the Department of Defense, which offers guidance in design in many areas related to the preservation, packaging, and packing of guided missiles.

We are also investigating methods of protecting, in shipment, various sensitive instruments, electronic tubes, and the like. In one of these studies with electron tubes, we ran fragility tests on the item. The data were used in the design of the package.

The Navy is conducting an investigation of packaging for long-term storage of protective clothing. The clothing is a special problem because it is impregnated for use against chemical agents. The packaging must not be affected by the impregnants, nor permit excessive deterioration of the clothing.

We are looking for a lightweight antimagnet shielding material for the shipment of magnetrons which will enable us to handle shipment without the bulky weight and troublesome preparation that is now required.

The Navy has conducted investigations in the area of complete aircraft preservation. We have used dehumidified storage, strippable coatings, and specially designed envelopes.

In the areas of materials handling, the Navy has conducted investigations on the design of pallet-loading patterns so that the most efficient use can be made with known carton sizes and pallets. Charts have been prepared as guidance in this area.

We are working on the investigation of test procedures for use in conjunction with acceptance of preservation and packaging under Specification MIL-P-116. We are always faced with the specification at the end of the line in order to assure ourselves of acceptable quality.

In shipboard handling there are many problems relating to replenishment at sea, and we are working with all types of conveyor systems for bulk fuel and oil, and solid materials

transfer, and we welcome any suggestions in that area. Of particular interest in materials handling aboard ship is the design of a forklift truck which, under the pitching and yawing and maneuvering of the ship, will still maintain its attitude and perform its function. I have some requirements data here: (1) capacity is 4,000 pounds at 24 inches; (2) battery-supplied power; (3) stacking type forklift trucks for below decks; (4) stability and traction and braking so that it can be operated while the ship rolls 15 degrees to each side of vertical; (5) ability to turn in the minimum aisle width because of requirement for conserving shipping space.

Concurrently with this, the Navy is testing out deck structures, using a variety of gratings. We are now testing expanded metal gratings made of steel and aluminum. In some installations we are testing wood decks with specially prepared gritty surfaces. This is an effort to solve traction and stability problems for improvement of decking construction.

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Research and Development

Discussion

MR. KUOPPAMAKI: I would like to ask a question about shipping dynamics. This is a meeting of coordination, of course. We would greatly appreciate coordination in types of shipping anticipated in the military transportation. From the standpoint of dynamics anticipated, we have been reading about the program which the Air Force has been doing for several years. We have lots of reports of those studies. We learn about them. Is the Armed Forces Studying Shipping Dynamics? It would be of interest to learn if there is any plan on coordination regarding classification of different kinds of shipping. In regard to the load which we expect the container gets.

MR. BOWMAN: I think that is a part of the overall program in our study of cushioning materials, to evaluate each material and finally, perhaps, have the data to draw curves or determine formulas for the determination of the amount of particular cushioning for a predetermined load. Is that what you had in mind, or do you question more than that?

MR. KUOPPAMAKI: We had a very good presentation yesterday from North American about cushioning. There we saw that the elastic behavior of the cushioning material itself is fairly simple to approach. But the load we have to decide--that is something which is, so far, completely open and undetermined and so complex in nature that it looks to one evaluation office that the only solution for it would be to put the load in certain shipment classes, which represent a given quantity group of load.

LIEUTENANT MARTIN: I think the question you are getting at concerns the service conditions project we have running, where we are sending instruments concealed in packages all over the world and getting the data back to find out what kind of conditions we have in the field. The first step in the program will be an investigation of air shipment because for years people have said air shipment should have preferred handling. That is one of the things we would like to find out. Are the handling operations in air shipment as severe as those encountered in surface shipment? We have had some correspondence with the Naval Ordnance Laboratory on this subject, and we are working together on this field.

MR. DECOT: I would like to ask about the present status of the air-cargo development?

MR. BOWMAN: That is an AMC project. I am not familiar with the air-cargo development. I would suggest that subject be taken to a representative of AMC here--perhaps Mr. Paul Curtis--or by writing to Wright-Patterson Air Force Base. I am sorry we can't give you the answer to that.

MR. KUOPPAMAKI: I would like to ask about the MIL-D-3464B. You said a new specification is now in hand for one type of desiccant.

MR. SCHWARTZ: It is a performance specification still. There is no more Class 2 non-dusting desiccant.

VOICE: You will not be eliminating one type of desiccant?

MR. SCHWARTZ: You mean the basic material?

VOICE: Yes.

MR. SCHWARTZ: No. I said non dusting--bagged desiccant.

VOICE: I would like to ask Mr. Schwartz a question. There have been a couple of references since these conferences have started about the directive that has been turned out recently on guided-missile protection, but nobody has ever given that reference. Do you happen to have the technical directive that covers it?

MR. SCHWARTZ: I just have the title. It is a DOD handbook.

MR. WILLIAMS (Cadillac Products): I would like to direct a question to Mr. Bowman. If I remember correctly, in the beginning of his speech he talked about some way of protecting a complete craft in polyethylene.

MR. BOWMAN: The material more than likely will be 15-mil polyethylene. It will be just a complete envelope, as much of it prefabricated before assembly as possible, but it will be necessary to heat seal the sections together when slipped onto the aircraft, so there are acute angles and small archs to seal.

You can see the problems. There was one heat sealer developed that had jaws which opened more than just the amount generally opened for the admittance of the sheet material. This sealer was evaluated in our place. It still didn't seem to have the maneuverability required.

As I said, we are going to put this out on a purchase request for contract, so it is possible that we will get something better than that.

MR. WILLIAMS: Are you going to put the wheels and everything else in it? Are they going to be enclosed?

MR. BOWMAN: The wheels will not be in the envelope. It will be from the wheel strut up. Everything but the wheels.

MR. WILLIAMS: You are going to seal around the wheels?

MR. BOWMAN: Yes. Everything but the wheels.

MR. KALAPOS (Goodrich Chemical): Mr. Bowman, on the same subject, have you considered any other films, such as Vinyl films; and if so, what were their limitations?

MR. BOWMAN: We haven't at this time, but we are receptive to any material which will have a low MVTR rate, be sealable, and be suitable for this purpose. We want the most efficient and economical material for this particular use.

Polyethylene is, of course, adaptable to heal-sealing. I think that is probably the main reason we mention polyethylene in this discussion. It is possible this could evolve into other materials.

MR. TIBBETS (Bakelite): I would like to ask Mr. Bowman how this differs from the packaging procedures that were conducted about three or four years ago on the complete aircraft at Wright Field?

MR. BOWMAN: The procedure is probably the same. That attempt several years ago had several shortcomings that we now hope to correct with further investigation. One of them was the looseness of the envelope. That, of course, created a tearing by flapping in the wind. A good tight envelope, probably using the same procedures that were used before, but being tight, would do the job. Getting it tight seems to be the big problem.

MR. TIBBETS: I seem to recall that some aircraft that were shipped top side on carriers were whipped to some degree, but the tightness of the wrap had a lot to do with its integrity.

MR. BOWMAN: I believe that attempt would have been successful if the envelopes had been tight. Being able to flap--it tore, requiring a lot of repair in shipment.

MR. OLEVITCH: I think the essential difference between the last approach and this one is that we are going to try to have prefabricated sections. In prior attempts, everything was done right there at the Air Force installation by hand If we have sections prefabricated by industry, we will have a minimum of heat seals to accomplish in the field. The fewer heat seals we must accomplish in the field, the less trouble we are likely to have.

MR. WILLIAMS: I want to offer a little suggestion. You fellows should tape all patterns together and flame seal the final enclosure--that will give you easy contour sealing. It takes time and it is all done by hand, but if you are worried about getting around some of these fancy contours, it does a pretty good job, and it will give you a skin-tight job, too, when you are done.

MR. SCHAFER: Mr. Schwartz, you mentioned you were interested in coatings for drum protection. Is that external or internal protection primarily?

MR. SCHWARTZ: Both internal and external.

MR. SCHAFER: For empty or filled drums?

MR. SCHWARTZ: For both purposes.

MR. SCHAFER: What type of protection?

MR. SCHWARTZ: Frankly, I don't have the details on that. The laboratory at Annapolis is working on the evaluation of the coatings.

VOICE: You expressed a wish that the industry should specify the fragility of their products, which would be a guide for the packaging engineer. Is there any specific publications giving criteria on this fragility?

MR. GRUNDY: No. This is a new field we are going into. Why we put this question to industry is the fact that they should be vitally interested in the fragility for their own items.

There have been no standards set up and no standard test method yet set up to obtain these factors. That is all being taken care of right now.

As regard to the Quartermaster Corps, in this project work we have under way, it will be a considerable time before these standards are set up.

VOICE (U. S. Navy, Naval Air Station): I just got back from putting in two weeks at the Joint Military Packaging School at Rossford Ordnance Depot. I believe you people are acquainted with it. As I understand, industry and military send their key personnel to these schools, to go back to their establishments and incorporate some of their ideas.

Now during this symposium here I have heard new techniques being used, such as Teflon and VCI. At this school there was a little dwelled on VCI. They didn't seem to have too much information on it. There was nothing on Teflon. I was just wondering, why don't both people get the information so they can pass it to the students attending the school?

MR. STUDLEY: I happen to be chairman of the advisory committee for that school. What you say is ideal, and I am for it personally. But it is just about impossible. However, very recently we went over the whole course and tried to liven the whole thing up with current thinking, current events. I don't just know the day the new course is going to start. There is a whole lot more, particularly on VCI, because I looked over several pages of VCI material and had it cleared with the Navy and the Air Force. We are attempting to do it, but you can't hope to keep a school up like

that in line with the very recent thinking such as Teflon, which we have given you here. It would just be impossible unless we give up all our other work and do nothing but work on the school.

MR. SCHWARTZ: For one thing, Teflon is still rather new. It has only recently been taken out of the research and into the development stage, so far as application is concerned. It is a material which at the moment has to be under some control. I don't know what purpose it would serve to go into it at the school except to mention it, and I don't know how that is incorporated into the course program there--current events, or something like that.

MR. STUDLEY: That material is basic material.

VOICE: It seems some of the agencies are using it--the WCI, for example. Evidently Teflon is being used by some of the agencies.

CHAIRMAN: Teflon's main use up to the present time is as a solid lubricant, but it has great potentialities as a corrosion inhibitor. It still needs more study. The reason it was introduced was to try to get other people interested in it.

I happen to be in the laboratory where the first work was done on it. One of the purposes of this conference was to bring to the people in the Government as well as Industry--new fields in which reserach needs to be expanded. That is one of them.

VOICE: Why were Class 2 non-dusting bags eliminated from the MIL-D-3464?

MR. SCHWARTZ: We are being practical. I think that is the only answer I can give you. We are getting service out of the bags that we were procuring. We weren't getting anything different for Class 1 or Class 2.

VOICE (Douglas): If a bag accidentally breaks beside a guidance unit, it may cost ten or fifteen thousand dollars to rehabilitate the unit if the duster is small enough. The particle size is such that it may be difficult to remove in this guidance unit.

MR. SCHWARTZ: The current draft of the specification

has incorporated some changes in the rough handling requirement. I don't know how far it has gone in any change in the particle size. I don't seem to remember any change.

CHAIRMAN: In summary, we need to develop a moisture barrier material which is compatible with synthetic oils and greases. So far we have not found anything actually adequate for packaging lubricated or greased bearings, and so forth.

We need to develop a truly oil- or grease-proof wrap. Yesterday a gentlemen said they had an oil-proof paper. On further questioning it turns out that it is oil-proof to petroleum and not to synthetics. In the military we need one oil-proof for synthetic oils because of low- and high-temperature problems in which we cannot use existing petroleum oils.

There should be further research on Teflon or similar coatings, with the emphasis on protective coatings--permanent type for packaging and use.

We need to emphasize the use of raw materials, which are plentiful during war time, for the developing of new wrapping materials. We need something to replace aluminum. Aluminum is very short in war time. We need something to take its place, something that can be made available in large quantities.

We need to utilize or develop rot- and corrosion-proof materials for global packaging, to protect equipment from outside environment.

With the vast amount of research on different plastics, there should be one that could be utilized in the wrapping of materials that could be stored in the tropics in which the fungus, parasites, and so forth, would not degrade or rot it away from the outside in, and destroy the package. We need a clear plastic material which can be stored down to minus eighty without becoming brittle.

We need a strippable film, capable of being applied by dipping at room temperature, that must deposit enough film for protection at one dip.

Are there any other points of interest?

VOICE (Yards and Docks): I think a plastic material with a low-vapor transmission, that you can see through, would be one of the big things to help us.

CHAIRMAN: A plastic material with a low vapor transmission which you could see through would help the Bureau of Yards and Docks.

MR. BROWN (Signal Corps): Is there any central point of clearance of the different projects? It seems to me I see floating through the same thing in Ordnance, in the Quartermaster Corps, and I know it is in the Signal Corps. Is a central clearance for all the different studies being performed at the centers?

MR. STUDLEY: No, sir. There is, but it is so high up, and it is a level that is not practical to get an answer to what you are after.

I see what you are after. Each of the technical services within the Army reaches to a high Army level where their primary interest is one of over-all budgeting and, in general, seeing that there are no overlaps of effort. I don't know whether there are other angles, too, but not of the type of interest that you have.

MR. BROWN: It would be contact directly between two people.

MR. STUDLEY: Contact directly. Unfortunately, if I want to know something from Sam in the Navy, I have to contact him and he has to contact me.

MR. SCHWARTZ: There is circulation of the project cards between the bureaus of the Navy, and we get them from the Army periodically.

MR. STUDLEY: The trouble with that is: you get the project cards and they are usually written in rather formal language. There may be some sub-project or some little thing you are interested in, but it isn't going to show up.

MR. BROWN: That is what I had in mind.

MR. GRUNDY: The Army packaging keeps close control--

MR. STUDLEY: Within the Army, the Army Packaging Board has a report at least once a year on all the projects. They call the boys in to see what progress has been made. Once a year seems to be often enough, and that is about what we do.

MR. MANNING (Reynolds Metals): I arise simply to question your statement about aluminum being too critical in time of war. I have been spending three days here looking for new ways that aluminum foil could perhaps be used because we are of the opinion that in event of war there will be a rather abundent supply. If we weren't so convinced, I wouldn't be here now.

It so happens that we find this same feeling around in a great many places--except at the top. You must realize there is ten times as much aluminum in production today as there was in the last war, when it started. It is growing very fast.

Of course, in war time, steel, rubber, wood, paper, and everything else, is short. But I think if you will look on the latest critical list that has been published by the Office of War Mobilization, you will find that aluminum and many other of these materials are much further down on the critical list than they used to be.

CHAIRMAN: I realize that. I realize that aluminum has made terrific increases in production. But thinking back over the last war, we didn't have enough aluminum. Usually during an emergency we have so many places to use it, we don't want to be caught without. We hope that we don't have any more wars in order to have to use aluminum; but if we should, I hope it will be available, and maybe we can also have something else to supplant it in case we actually need it.

VOICE (Bureau of Aeronautics): In your proposal to use Twist Lock enclosure for the 605 containers, have you considered the presently designed inserts used in the 605 containers?

MR. BOWMAN: We are considering that. The only portion of the container which will be in any way different from the present container will be the very top of the container.

There is still clearance, the same clearance as was provided in the other AN can, according to the old drawings. So inserts and any use for which the drum has been played in the past will still be usable for the twist lock drum.

VOICE (Bureau of Aeronautics): I recall sometime ago I did see the threads at the top were stamped and probably took off maybe a quarter of an inch or three-eighth of an inch from the I and E container. That was my impression at the time.

In the crate-type of inserts, it seemed to me there was a closer tolerance than that. That was the basis of my question.

MR. BOWMAN: Thank you. We have considered that and in the revision of the drawing from the bolt and range to the twist lock. We have considered the use of inserts and the entire usable dimension.

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Afternoon Panel Session

Wednesday, October 12, 1955

Panel Session B-2 Wednesday PM Oct. 12, 1955

Unitization Within the Air Force

Mr. James H. Johnston
Air Materiel Command, Department of the Air Force

Gentlemen, the conference will be in order.

I am Mr. Johnston, from Headquarters, AMC. We are here to talk on unitization, to try to help you and have you help us.

I imagine you are confused by now — I know I am — after two and a half days.

I thought I knew what I was doing a lot of times, too, but I find a lot of other people have good ideas which I hadn't thought of. So, when I get home, I sure am going to try to digest all the speeches I am concerned with.

I will pass this around and will ask you to sign it, so that we may have a record of the attendance.

This afternoon we plan to do this: We have four speakers here — Mr. Akrep, of the Navy; Mr. Oliver, from the Quartermaster; Mr. Jordan, from Forest Products Laboratory, and myself. We will each give our talk and we will follow that with a 15-minute question-and-answer period. At the end of the 15 minutes, we will cut it off and let the next gentleman speak. In this way, those who have to get trains can at least be out by three-thirty. If further discussion is warranted or wanted after that, we will be here to answer your questions for you.

In the past two and a half days I have rewritten my talk ten times in my own mind, but I believe I will let it stand as is.

We of the Air Force have tried to unitize from the word "go." We are having pallets made, tested, and there are regulations out now which say supply items shall be unitized.

We don't give a second thought until somebody says, "I can't do it," or "I don't like the pallet I'm getting," and I have to admit that at this time we have asked why many, many times. Each time has given us some information, shown us problems, and we have attempted to solve them, some of them quite big.

In the shipment by rail, truck, and air, they had their problems with this changeover, due to lack of equipment,

including the proper type of pallets, personal resistance to change, changing the package line, both civilian and military, and finding an acceptable tare weight for air transportation, which is basically what the Air Force is interested in.

To approach these problems, we had to line up our criteria for unitization from an Air Force viewpoint. The factors we lined up in the order of their consideration were:

(1) We have accepted the 40 by 48 basic pallet size.

This may change in the future, but this is our starting point.

(2) Tare weight.

Tare weight is necessitated by the high cost of operation of cargo aircraft. Mainly in these air-lifting problems, we run out of weight before we run out of cubage on these aircraft. We hope to rectify this from both ends, both with the aircraft and with the cargo we haul.

(3) Floor-bearing weight of the pallet.

We have to have specially designed skids so that the aircraft floor is not overstressed. We maintain nesting of containers, full or empty.

We have to have stacking capabilities. This will cut down, tie down weight in the aircraft, and also, it eliminates the necessity for shoring on the aircraft floor, which means both time and money.

(4) Usability.

This is a broad area which affects everybody and ranges from introducing new methods of unitization in the present packaging lines with a minimum of modification, loadability of unitized loads, both at terminal and under field conditions, to the condition of the cargo on final delivery.

(5) We class mobility of the pallet as a prime feature. This is becoming more of a reality every day as these concepts advance, and this we get with an increase of tare weight.

In many instances, this mobility may offset tare weight through savings in the depot, terminal, and where have you.

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In combat effectiveness, you may pay for tare weight, which would be entirely justifiable.

With this criteria in our mind, we have attempted to coordinate with everybody and evaluate all studies we could get our hands on, and we have set up various goals for the pallets and containers we desire.

In the utilization of a flat pallet, we are still trying to find a durable flat pallet with a 17-pound weight limit, and with a design-load capacity of 1,500 pounds.

Our goal appears to be in sight with new materials being developed, and we have every indication we will get it in the near future.

We desire that the cost not exceed one dollar per pound for this pallet, which is $17. One of the remaining criteria in this pallet is that we don't like to see them get water-soaked. This adds to our tare weight.

An expendable flat pallet has not yet been developed which we have latched onto.

Since I have written this speech, it has taken a reverse in the last few weeks. We are going to reinvestigate a lot of flat pallets that were introduced to the Air Force and may try some of our own. Here we would like to see something less than $2 per pallet.

You may have heard this morning the Air Force is receiving initial distribution of the Conex containers. These are strictly for overseas shipment of furniture, nonperishable foodstuffs, and we are trying these things to our own adaptability, and also getting our feet wet in the use of them.

NEAC is supposed to be shipped cargo in each container. In NEAC we have the problem of cold weather and lack of equipment. In Teheran pilferage is one of the main problems. So, for overseas shipment we are getting into the Conex container pretty deeply.

There has been one definite step towards Air Force unitization: All contracts will now contain a clause, wherever feasible, for all like items being shipped to a consignee to be palletized. Where limited quantities of different items are shipped, consolidation may be accomplished.

This gets into some paper work. It isn't as simple as it sounds a lot of times. It affects both you as the contractor, and we of the Air Force.

This is one area that the Air Force will have to work out to make unitization 100 percent perfect, if we can get that far.

In the area mentioned above, that of unitizing the small quantities of individual items, lies the greatest problem.

The Air Force supply system contains a large number of high-dollar items, which are requisitioned on an as-needed basis. It is mandatory that these be air-shipped to destination.

There are many items -- maybe resistors, condensers, that you can put in one envelope; but today's way of doing it is to package in a large box. While this box is acceptable, it may be containerized.

Our goal is to take off this outer packing, put it in the envelope alone, with many other items, and ship it as requisitioned.

Along this line we have developed a collapsible, aluminum container 40 by 48 by 32 inches high.

The height was dictated by maintaining the maximum available cubage we could get and still maintain ease of loading for the packaging personnel on the packing line.

How deep can you reach into a box? This was the deciding factor because these boxes will be packaged at the Air Force packing lines, in the depots or the terminals.

The cubage of this box is 25 cubic feet available cubage.

The capacity, at 17 pounds a cubic foot, is 425 pounds.

The container weighs 68 pounds.

This makes a tare weight of 16 percent. It has static capacity of 3,400 pounds.

It has stacking capabilities, in that it has lugs on top and recessed portions on the bottom, so that when you stack one on the other, they don't slide off.

There is four-way fork-lift entry.

With skids, it has a necessary bearing area to be stowed on aircraft floors and be movable on gravity-conveyor systems. This is a must.

We anticipate packing the items in a container stripped of all outside packaging except the necessary corrosion packaging.

The container is not waterproof. Where this is anticipated, you can line the container with waterproof paper.

Now, a little further explanation: We do not anticipate storing these items any place in the containers. They will be strictly for air shipment.

Aluminum, as I heard somebody say this morning, gets damaged. This may be true. It may be this will be the outcome; but, on the other hand, in line with our goal, if we can have a gravity-conveyor system — this is a possibility — from a packing line to the terminal to the aircraft, you don't have the up-and-down fork lift, materials handling and tossing of the container.

This again goes to the inside. I will admit we may start putting the packaging back on the boxes little by little.

These containers will be distributed world-wide in the near future, and that will possibly be the first of next year.

There are going to be a number of problems crop up. One thing we have incorporated is the segregation of the cargo. We thought first we would just pile everything in a box; but then, when that man unpacks it, there is the problem of finding that little envelope of resistors. So, possibly separators will be used.

This will also aid in documentation.

Now, we have to work out just how we are going to efficiently secure these on the aircraft floor. There is no major problem. It is merely going to be a time-saving problem.

We are going to gain information which we do not have at our hand on densities of air shipment, various stock classes which will be susceptible to this type of unitization.

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We are talking high-priority stock, and we are going to see how far we can go down to low-priority items for air shipment.

It may be we will have enough containers so we will supply them to contractors when they have a contract. This will reduce their time and the Government's money.

The Far East Command has been testing the transit van which you may have heard about, and they have also taken the individual containers of one of these vans out and are shipping them individually from the Far East to Ogden, San Bernardino, Kelly, and these depots have been shipping back to FEAF, items they have requisitioned.

There have been problems come upon this distribution of containers. We don't want to tie these containers up in paper work that is necessary. So, we are trying to find the easy way out on distribution because some of these depots are getting more than they shipped out. This is being worked out.

Even since this paper was written there has been another thought on using fibre board containers. There is one manufacturing company currently using fibre board containers for air shipment in the Air Force.

We are going to follow this through. This company does have all the necessary packaging around the individual items. So, our first step is to consolidate a report on how the container is arriving. If the outside container looks good, with no damage, this is the place where we will start stripping the inside and see if we can come down to the corrosion pack.

On mobility — I haven't brought this in to this point — we are taking two avenues of approach. One is the use of a master type pallet, and this is important for the air-shipment purposes.

One of the main things to be found out is the desirable size of this pallet. This will be dictated by adaptability to all end loading cargo aircraft, weight restrictions and ease of off and on loading.

Loading of these pallets by gravity conveyors or possibly side-loading fork lifts, or perhaps other means will be used.

Another method is the use of a low silhouette, flat-bed type trailer.

Now, this parallels the transit van, except we have taken off the van portion of it.

This will provide maximum mobility of movement of supplies in and around the depots, terminal areas, and will reduce the turn-around time of the aircraft.

The trailer may be loaded in several different ways: with the standard container I mentioned previously; the standard 40 by 48 pallets; banded type cargo; individual items of equipment or combinations of the above.

The cargo may be loaded and secured on the trailers in the vicinity of the packing lines or, if they consolidate cargo in the terminal, it will take place in the terminal.

The height — when I say "height" I mean if you are using containers, the number of containers you stack high — and the weight also can be regulated, allowing transporting with wheels in such aircraft as 119 or 123, where height is restrictive. Load also enters into this.

There is also tactical mobility for ammunition or equipment flown into the combat areas. The plane may be landed, the tailgate dropped, and the trailer pulled out, and away goes the aircraft. The trailer can then be pulled to a less vulnerable area for requisition of supplies.

This trailer is also being considered for the movement of administrative and organizational equipment, where a wing or group is ordered to move in twenty-four hours, and they have to pack up. They can put their paper work on this trailer, the plane lands, and away they go.

This has been a brief summary of what some of our goals are and the direction the Air Force is heading, particularly in air shipment.

We say there are a lot of problems that arise and the lead times of development and procurement have prolonged our reaching this goal. But from you who are in industry we have received good cooperation in the past and, with this cooperation, I believe the Air Force can realize its goal in the near future.

I thank you, gentlemen.

I entertain any questions.

MR. H. R. GREENLIN (Chief, Classification Section, Office of the Chief of Transportation): Mr. Johnston —

CHAIRMAN JOHNSTON: Pardon me, sir. Before you start, will you, when you ask a question, mention your name and affiliation?

MR. GREENLIN: I will be glad to.

My name is Greenlin, G-r-e-e-n-l-i-n, and I am Chief of the Classification Section, Office of the Chief of Transportation.

My problem is saving money in Government freight charges. I am very much interested in this unitization program, to the extent where you pack a number of articles rated differently, the rating on the highest rated article in that pack is applicable on the entire pack.

Now, I have a program going on now where we are trying to get reasonable ratings, and we are doing so successfully on sets, and invariably on some of these sets we will find a pair of goggles in it that may weigh a half a pound or a quarter of a pound, and that will mean, because of that pair of goggles in there, the entire package will take a rating of 100 rather than Class 45, which will be double the rate.

I am just wondering: In this palletizing, has that been taken into consideration?

Are you considering it logistically, unitizing this stuff to a point where the freight rates would be the same as far as surface transportation is concerned?

CHAIRMAN JOHNSTON: Sir, I am not familiar with that portion of it. I would like to pass by that. I am not in the paper work portion, and stay away from the paper work.

MR. GREENLIN: Well, it is something I think is really important.

CHAIRMAN JOHNSTON: But does this parallel your question: The Eastern and Western railroads came out with a new rate for containers and pallets.

MR. GREENLIN: Yes. We got that. I was responsible for getting that, even in the Conex, sir, where you can load anything in the Conex, with the possible exception —

You gave out a thought that you were going to eliminate a certain amount of packing.

CHAIRMAN JOHNSTON: Yes.

MR. GREENLIN: Now, we had to agree with them when we put stuff in that Conex we would still meet the packing requirements of the effective classification or tariff.

CHAIRMAN JOHNSTON: This is true, sir, in this packing, mainly air shipment, where we won't get the balance of the railroad jiggling, and, as I say, this is going to depend on a lot of things. Pallet cargo itself takes it. If we can mechanize from the packing lines to the aircraft, you won't have this handling, which is where all the damage comes in. You won't have a man picking up a pallet. He will pick it up with a fork lift.

MR. GREENLIN: Yes.

CHAIRMAN JOHNSTON: How much is this going to reduce damage?

MR. GREENLIN: Well, that is a phase which has to be studied --

CHAIRMAN JOHNSTON: That is right.

MR. GREENLIN: -- and the proper judgment made as to whether our handling will overcome our freight transportation charges or whether it will be better to ship that goggle that I spoke about before by parcel post --

CHAIRMAN JOHNSTON: That is true.

MR. GREENLIN: -- and ship the rest of the stuff at whatever rate it is going to be. However, I will say this: We are trying at the present time to get the carriers to accept palletizing on the same basis as they are accepting the Conex containers, that is, the rail carriers.

CHAIRMAN JOHNSTON: That is a problem, that is certainly true.

MR. GREENLIN: But I think we should all remember that there is a problem there of freight charges.

CHAIRMAN JOHNSTON: Yes, and the same way with documentation -- for each item in there apparently you still need

so much paper work, and this we cut down, and this has to be an Air Force problem in supply which is going to have to be answered also.

Are there any more questions?

MR. S. O. TORMYSON (Ordnance Corps, Department of the Army): I gather, from what you said, you folks contemplate procuring your items packaged by the manufacturer, producer, and then exposing yourself to destroy the pack or unpacking at your depot for forward loading; is that correct?

CHAIRMAN JOHNSTON: I believe the thought, if I am in line with you, sir, is that if we have enough of these containers, just like the Conex container, when we get enough of them, if you, as a manufacturer, get a contract, we would ship you so many containers and say, "You pack them in here and ship them to Ogden," or wherever they are going.

Now, as far as taking off the packaging, this is a study. Right now a contractor is shipping container items for us. As I said, he is leaving on the inside packing; and when we start telling him to take that off, we are open. So we are going to start, I believe, with some low-dollar items first, not high-dollar, and see where the drawing line is on this, and then go from there into the high-dollar items, and so forth.

MR. TORMYSON: Roughly 15 percent of your procurement dollar goes for packing.

CHAIRMAN JOHNSTON: Yes.

MR. TORMYSON: The shipments, perhaps, could be engineered further back from the depot with some degree of success, to the end that you would save some considerable portion of that packaging dollar.

CHAIRMAN JOHNSTON: This unitization from the manufacturer to the depot is always a two-way deal, because the manufacturer can save money, but is the depot up to receive it?

Our depots at times are not fully capable of receiving palletized loads, but this is being worked into the system.

MR. TORMYSON: Yes.

CHAIRMAN JOHNSTON: Time and money will satisfy us.

MR. GREENLIN: I presume, Mr. Johnston, any of these pallet packs you make will be coordinated with your transportation specialists. I think Rhodes is still handling that deal of his at — is he at San Bernardino?

CHAIRMAN JOHNSTON: Yes. We are going to have to work with the depot.

MR. GREENLIN: I think that is a splendid idea.

CHAIRMAN JOHNSTON: Yes, sir.

MR. D. C. BROWN (General Services Administration): Did you mention the cost of that collapsible, aluminum, light-weight container?

CHAIRMAN JOHNSTON: I haven't, sir. They haven't procured them yet. We don't know. We think — I will cross my fingers and say, $50, but it might be more.

Any other questions, gentlemen?

Yes, sir.

MR. LEE W. OLIVER (Office of the Quartermaster General, Department of the Army): This light-weight pallet, which is the seventeen-dollar pallet — how thick is it? How high?

CHAIRMAN JOHNSTON: Standard.

MR. OLIVER: Standard height?

CHAIRMAN JOHNSTON: Yes; four-way fork lift.

MR. OLIVER: Do you think that would be suitable for rail shipment as well as air shipment?

Is it sturdy enough to take a rail shipment?

CHAIRMAN JOHNSTON: I would say yes. It is going to have to be.

MR. OLIVER: But you are thinking of it in terms of the one trip?

CHAIRMAN JOHNSTON: No; not the 17-dollar pallet.

MR. OLIVER: You are not reusing that?

CHAIRMAN JOHNSTON: This is a regular pallet, and, of course, no standard 129, I believe that is a correct statement, except we don't want it watersoaked.

I am not saying it should be wood. If they can take wood and preserve it so water won't get in and increase the tare weight, we will buy it. It looks like metal right now.

MR. OLIVER: What is the approximate ratio of the weight of our standard wood pallet in this light weight?

MR. ARNOLD (Fairchild): Eighty pounds.

CHAIRMAN JOHNSTON: About eighty pounds dry, isn't it, and a hundred and some pounds with water? I am not too firm.

MR. ARNOLD: The specifications —

MR. OLIVER: Your new pallet you are trying to get is 17 pounds?

CHAIRMAN JOHNSTON: Yes.

This is again for air shipment. We can't tell you now where we are going to use the expendable pallet, where we are going to use the durable one. If it is just the items stacked in the depot, it will probably be the durable pallet.

If it is, say, from the manufacturer to the depot, where they break the pallet down immediately and distribute the stuff, then it is an expendable pallet, one-time use.

The use of the pallet and container we are trying to take into consideration and come up with an answer, but there are many problems.

MR. DALE D. DOERR (Kaiser Aluminum): Do you have specifications set for this master pallet?

CHAIRMAN JOHNSTON: No, sir. That is coming out. We haven't had too much to do with that.

MR. ARNOLD: On your expendable pallets — will they give floor distribution or are you going to have concentrated loads?

CHAIRMAN JOHNSTON: We will probably have to have floor distribution; possibly conveyors, too, because, if we set them up, we can't say, "This was an expendable pallet; we can only take so much."

The wood has to go in this packing line. They are all going to have to go down the same packing line. The floor-bearing characteristics will all be the same.

MR. ARNOLD: What about skid pallets?

CHAIRMAN JOHNSTON: The Air Force makes skid pallets.

MR. ARNOLD: I mean a lot of times you have to skid the pallet to get it in place.

CHAIRMAN JOHNSTON: Well, this is a case — maybe this is another factor — where the expendable pallet is going to be light. So, the man drops it on the corner of it and mashes it. All right, it is going to take five minutes for someone to pry that thing up and get a fork lift underneath it. Is this cost going to be offset?

We have taken this as a big problem. We don't guarantee any answers. We are going to find a lot of them. There will probably be slaps in the face on a lot of them, but we are going to try it.

Now, Mr. Clarence Jordan, from Forest Products Laboratory will speak to you next.

I will let you give your own title, Mr. Jordan.

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Mr. Clarence Jordan
Forest Products Laboratory

The Air Force has among its many supply problems one that is quite unique from a packaging and unitization standpoint.

The Packaging and Materials Handling Division at Air Materiel Command Headquarters, Mr. Johnston's office, asked the Forest Products Laboratory to study this problem and make recommendations for possible improvement in current practices, even to the extent of designing new containers where presently used ones were found to be inadequate.

The problem arises from this possibility: The Air Force may be called upon, on extremely short notice, to supply spare parts to keep aircraft flying in sections of the world where no established supply system exists.

For that period of time between the start of such a mission and the time that regular supply lines can be set up, some stopgap measure of supplying the spare parts needed to keep the airplanes flying must be relied upon.

To meet this end, the Air Force has established what they referred to as their readiness reserve program. In this program the spare parts needed to maintain a given number of a certain type of aircraft for a specified period of time are preassembled by kits and stored in various parts of the country. In the event of need, these kits will be air-lifted intact to the new area of operations, to rendezvous points in or near the new area of operations.

There these parts are assembled from regular Air Force stock. They are sent from depots scattered throughout the country to assembly points by public transportation, quite often parcel post in the case of small parts.

Thus the items are usually received at the assembly point packaged for surface shipment.

Because these kits are assembled from many sources and over a considerable period of time, they become the recipients of many small packages containing small items.

This can be realized better when one considers in a recent study it was found that 73 percent of the unit packages of Air Force supply items are less than one pound in

weight; 91 percent are less than 5 pounds — I believe Mr. Curtis mentioned that in his talk yesterday — and, further, that 93 percent of these items are under 500 cubic inches in size. That's roughly equivalent to an eight-inch cube.

Since the kits must be packaged in readiness for immediate air shipment, the small packages present quite a problem in unitization.

As is the current practice, the small packages could be overpacked in larger containers, usually fibre board containers of six to ten cubic feet capacity, and sealed ready for shipment. However, such a system has distinct disadvantages.

The spares in these kits are for aircraft that are constantly undergoing improvement through changes and modifications. In order to keep these spare parts in the kits up to date, it would be necessary to open and reseal these consolidation containers each time the change in these parts, dictated by a change in the basic aircraft, is presented to you; and, further, there are certain parts in these kits that require periodic inspection, possibly investigation checking, to be sure they continue to be serviceable.

In order to do this job, it would be necessary to open and reseal these consolidation boxes.

Another disadvantage of possibly greater seriousness is the fact that finding a needed spare part in a pile of these consolidation boxes might prove to be the proverbial needle in the haystack when the fellow received the kit overseas.

In order to overcome some of the difficulties of this system, particularly as it applies to small parts, the Forest Products Laboratory designed a new container. This consisted of a pallet box, equipped with water-resistant, corrugated, fibre board drawers.

I have a picture of this container. I don't think you can all see it if I hold it up; so I think I better just pass it around.

The outer case of this container is a quarter-inch weatherproof plywood. It is fabricated to insure watertight joints. The size is the commonly accepted 40 by 48, and the height is 40 inches, including four-inch high legs, that were provided to permit fork-truck handling.

The outer case is split vertically and hinged to open horizontally.

Each half is provided with sliding drawers made of waterproof, water-resistant corrugated fibre board of several sizes.

A gasket is provided around the abutting edges of the two halves to exclude water when the container is closed for shipment.

All of the drawers are twenty inches deep, that is, front-to-back dimension. All are four inches high.

There are 166 drawers four inches wide, and sixteen about eight inches in width, that is, as the container was originally designed.

In a later version we have provided fewer of the four-inch wide drawers, more of the eight-inch drawers, and some eight by eight in cross section.

Strips of reinforced, specially sensitive tape were provided to make door pulls by attaching opposite ends to opposite sides of the drawer near the bottom in the front, leaving enough slack in the middle to provide a handle, and the unattached center portion was folded upon itself to cover the adhesive.

The drawer locations were identified by a combination of lettering-numeral designation. For instance, Drawer No. B-10 would be in the B layer, which would be the second from the bottom, and the tenth drawer from the left-hand edge.

This is the same or similar numbering system to the one used in Air Force depots, indicating storage spaces.

Several of these containers were constructed and sent to one of the depots where these readiness reserve kits are assembled, and stored. There they were used with good success in repackaging the small parts in one kit that contains parts for one of the fighter type airplanes. This particular kit contained approximately 1,500 stock number items. About 1,200 of these items were repacked into one of these drawer—type containers. Another hundred were of unit packs that were too large to go into the drawers and not over about two cubic feet in size. They were put in one of these containers from which the drawers had been removed. In all, about six warehouse bin pallets full of packaged items were placed in just one of

these drawer-type containers, and one without the drawers. The saving in weight was about half. The saving in cube was about two-thirds.

Instead of sixty individual boxes -- there are sixty individual boxes in six bin pallets -- we ended up with the material unitized into just the two pallet boxes.

In repackaging the spare parts in these drawer-type containers, all of the packaging material over and above the unit pack -- that is, the unit preservation pack -- was removed.

It was reasoned that once the items were put in this drawer-type container, the unit pack, itself, would provide sufficient physical protection for the item.

The unit packages were carefully fitted into the drawers, filling the drawers completely, so that there was no chance of items shifting around in the drawers.

An IBM card was prepared by the Air Force for each item in the kits.

This card contained credit information on stock number, nomenclature, quantity of unit pack, and quantity required in the kit.

As each item was packed in the container, the drawer location was written on the back.

Then, with the deck of these IBM cards sorted in stock order sequence, the task of locating any item in the container became a very simple procedure. It is only necessary to know the stock number of the items you are looking for, and you look up the card for that item in this deck that goes right along with the container, look on the back and get the drawer location, go right to that drawer, and pull the item.

During the prepackaging operation at this depot, the drawers were opened and closed quite a number of times with no difficulty, even those drawers on the bottom, when all the drawers above were filled with items.

Several important advantages aside from substantial saving in weight and cube were obvious from the work done on these containers:

First, the items are readily accessible for withdrawal from the kits or replacement as changes, dictated by changes in the subject aircraft, are made during the storage period.

Secondly, items subject to periodic inspection during the storage period are readily available and easily located for such inspection.

The number of containers to be handled when the kit is shipped is greatly reduced.

The drawer-type containers could be set up at the receiving end and used as stock bins from which to issue stock.

However, the greatest importance, we believe, is the fact that when the fellow at the other end gets one of these kits, using these drawer-type containers, he will be able to locate the part he wants with a minimum delay. The ability to do this could conceivably mean the difference between success and failure of a mission.

Thank you.

Any questions?

MR. GREENLIN: Mr. Jordan, your organization was coordinated in the twin packaging, multipackaging of automobile items during World War II. I made quite a study of that.

MR. JORDAN: Packaging of automobiles?

MR. GREENLIN: Automobiles, trucks.

MR. JORDAN: I think we did some work on that.

MR. GREENLIN: I want to congratulate you people on it.

MR. JORDAN: Thank you.

MR. GREENLIN: Because I think you did a marvelous job. I want to get that plug in for you.

MR. JORDAN: Thank you.

LIEUTENANT COLONEL T. K. PEXTON (British Army Staff): Are these cabinets strong enough to stand one on top of the other?

MR. JORDAN: Yes. They are designed for four-high stacking.

COLONEL PEXTON: Four high?

MR. JORDAN: Yes.

Any other questions?

MR. GEORGE (Washington Terminal Company): Do you have any figures on the cost of a pallet of this nature?

MR. JORDAN: No; we haven't. These were designed merely for experimental purposes, to see whether the idea would work with these latest reserve kits.

It may be the Air Force will want to make them out of some other material, some light-weight metal, for instance, possibly with plastic drawers.

It is the idea of this container that we want to try out. So, we don't have any figures on cost.

MR. WEBER (General Services Administration): This is the type of container that also brings up the same type of problem the other gentleman brought up — different types of parts bringing in the higher freight classification, because of one particular item in the container. Do you have any studies on that?

MR. JORDAN: Understand these are for a special project which will be shipped out only in the event of need, and they will only go by air.

MR. WEBER: Oh, I see.

MR. JORDAN: So, the surface transportation rate differences won't enter in.

Any other questions?

CHAIRMAN JOHNSTON: Thank you, Mr. Jordan.

Do you gentlemen want to continue on or would you like to take a ten-minute break?

We are half through. We have two more speakers. Apparently there is a desire to take a break. So we will take a ten-minute break, and we can still finish by three-thirty.

Mr. Lee Oliver
Office of the Quartermaster General, Department of the Army

The Army is presently engaged in a series of test shipments in unit loads of nonperishable subsistence from depots in the eastern United States, principally to France and Germany.

The purpose of this test is to determine whether or not shipment in unit loads is more economical than shipment in loose packages.

The test is a joint project of the Army Transportation Corps, which has responsibility for the shipment of supplies, and the Army Quartermaster Corps, whose job it is to provide food, individual equipment, and shelter to the soldier.

Of these three types of supplies, shipments of canned food comprises the largest single tonnage of shipments to troops in overseas commands.

Canned food was also selected because the size and shape of the packages lend themselves most readily to the formation of unit loads.

A typical package measures about eighteen by twelve by seven inches.

In addition, the cans form a solid pack and have good stacking strength.

Unit loads are prepared by using the military standard 40 by 48 inch, four-way entry pallet as a load base.

This pallet was selected, in addition to its being the standard military pallet size, because it fits readily in rail freight cars two abreast, and also fits the usual truck body.

Cases are glued to the pallet and glued to each other by means of a standard adhesive used for this purpose, which provides high lateral stability, but which releases readily when the unit load is broken down at its destination.

It has been found that unit loads thus glued are easily broken down at destination with very slight damage to the containers.

At present two one-half inch strips of glue are being used on each case.

Three steel straps, of three-quarter inch by .035 are applied in the long dimensional load base and two straps of the same size are applied in the short dimension.

Steel edge protectors, six inches by six inches, are used under each strap on the edges to prevent strapping damage to the supplies.

The number of cases per unit load varies from thirty-six to fifty depending upon the can size, which results in a unit load of something over one ton in weight.

The size of the unit load was selected primarily as one which can be handled easily by fork-lift trucks most commonly used at military installations.

The unit load also provides an almost cubical package and can be stacked two high in a rail freight car.

These shipments began in July of 1955, and will continue for one year, with cost data being submitted each quarter.

Since the first quarter is just ending at this time, no cost data are available as yet.

The cost data being collected will include the cost of materials and labor involved in the preparation of the unit loads and all transportation and handling costs between the continental United States depot and the depot at the destination overseas.

A cost comparison will be made between the figures mentioned and the cost of shipping identical cargo to the same destination in loose packages.

In addition to the current test, the Army has also made several shipments over the past few years of canned food in unit loads which were unloaded from vessels onto beaches similar to the supply operation in the South Pacific during World War II.

The result of these shipments indicates that vessels can be unloaded in less time when supplies are in unit loads and then, in time of good weather at least, damage to supplies is considerably lessened.

In these beach unloading operations, it has been found necessary to increase the size of two of the steel straps to one and a quarter .035 from three-quarter .035.

Shipments of supplies in unit loads have also been made to scattered overseas areas where unusual storage and handling conditions prevail, such as to the Air Force bases in the far north, where the shipping season is short and the whole year's supply must be unloaded in a few months. In this instance unit-loaded supplies permitted handling by fork-lift trucks at the docks, in the warehouses, which made possible the handling of supplies by the year-around crew, while if loose packages had been supplied, a large temporary work force would have been required.

In loading ocean vessels with mixed cargo, it appears a common practice to use canned food as filler cargo, which is placed in scattered locations to fill spaces which would otherwise be voids.

When the vessel is unloaded, this means that canned food is unloaded from scattered locations on the vessel, and is thoroughly mixed up on the docks. This results in a tremendous job of sorting to get all the peaches in one place for storage, and all the beans together in another, and so on.

Unit loading almost eliminates this sorting job at the destination.

Shipments have been made to areas where native labor is employed. In these instances, the unit loads have considerably aided in storage since the arrival of supplies in loose packages has presented a very difficult sorting problem.

The classic story in this regard describes the native labor sorting job as resulting in the "use no hooks this pile" and "this side up over here."

In summary, the Army is presently undertaking to find out whether shipments of supplies such as canned food in unit loads results in an over-all economy in shipment. So far these advantages have been found:

Unit loads are a great advantage to overseas locations having a short shipping season.

Unit loads greatly reduce the sorting problem at overseas destinations.

Unit loads permit handling by materials handling equipment at all transfer points, thus reducing the manpower requirement.

Unit loads permit more rapid turn-around of ocean vessels at terminals.

In contrast to these advantages, the following disadvantages have been found:

Unit loading is an expensive operation to start with.

There is a loss in ship space, which in some instances amounts to almost 40 percent.

There is a loss of space in flooring of rail cars, to the extent that in most cases the minimum loading requirement is not met.

If the cost analysis which has been described shows a favorable balance in favor of unit loading of canned subsistence, it will undoubtedly be extended to many other items of supply.

Any questions?

Yes, sir.

MR. C. J. HEINRICH (Naval Supply Research and Development Facility, Naval Supply Depot, Bayonne, N. J.): I was rather surprised to hear you were both gluing and strapping your unit loads.

I would appreciate it if you could give us a little more information as to the necessity for doing both. I notice the glue widths that you are applying are half-inch widths.

The Navy has been experimenting with glue loads using three-quarter inch widths, but we have not been using steel straps. Of course, our tests have been confined to the domestic United States and not overseas.

Could you give us a little more information on that?

MR. OLIVER: Yes. I will be glad to.

I think you have answered the question when you pointed out that the glued-only load has been used for domestic shipment only. Our experience has been the same. As a matter of fact, in many, many cases we have used unit load

shipments from our depots to ports without gluing. For instance, at our two largest depots on the Pacific Coast, which are located approximately fifty miles from the port, that is the common method of shipment, to ship in unit loads just as they are taken out of storage, just on the pallet, and the truck brings the load of pallets back and it comes back to pick up another shipment.

However, our primary experience in unit loading of canned subsistence was gained when we were making over-the-beach unloadings, and there we found strapping was absolutely essential. As a matter of fact, in the early shipments we used strapping as small as five-eighths .020, because we didn't know what the proper size was. Almost all those straps were broken. Then we used three-quarter .035, and about half of those straps were broken.

Where we are going to have exceptionally rough handling in unloading at the other end, we put on two-inch and a quarter .035, and that carries very, very well.

I must say, however, this: When you go over and look at one of these shipments, as it is being unloaded from the vessel, and you find a lot of broken straps, it looks like hell. You think everything has gone to pot, but it hasn't. Even though there is one strap left or two, once it is unloaded and you get it onto the rail car or truck going to the depot, they can still be handled.

We in our early shipments did ship a few unit loads that were merely glued and our experience with that was very poor.

MR. HEINRICH: Is that due to severe handling they are getting, or is it due to inexperienced personnel doing the unloading there?

Is it due to something that can be corrected or will it be a necessity in future operations?

MR. OLIVER: I would say it is a combination of both of those.

We can't find any personnel who are skilled in the handling of unit loads of this type. It is new to everybody.

In some of these operations, some of these unloading operations, troops were used and, naturally, they had had some schooling and some training, but they were in the main inexperienced and that was responsible for quite a bit of the rough handling.

If you visualize another factor in this — and that is what happens to this ocean vessel on the way over — if it is beautiful weather like today, everything gets over there in fine condition; but if it is the wintertime and there are storms and the load shifts a little bit, then when you try to get that out of the hold, you are apt to run into an awful lot of difficulty, and when it is necessary to have your stevedores get into the hold and start breaking down these pallets in the hold, that slows up the whole operation tremendously.

I would like to say we are entirely open-minded on whether or not strapping is absolutely necessary, but my personal opinion in now that it is.

MR. HEINRICH: Thank you.

MR. OLIVER: Yes, sir.

MR. I. SHENDELL (Naval Supply Depot, Bayonne, New Jersey): Have you had any reports back on this, like in Germany and France?

MR. OLIVER: None as yet. This started in July. We are asking for quarterly reports and an initial report is due next Monday, I think, so that we haven't heard anything.

We have had observers from continental United States who have gone over and watched the unloading of some of these shipments and have visited supply depots in France and Germany and have observed the condition of supplies and have talked with personnel at the depots.

The people at the other end of the line like this from the point of view of unloading. It speeds up the receipt of supplies at the depot in Munich or some such place. They can unload a freight car in an hour or so that would otherwise take them a half a day. They put it directly in stock. They have less sorting. They like it.

The disadvantage — the only disadvantage — the only criticism — we have heard from Europe is the fact that our size of unit load that fits in our rail car isn't any good for their rail car. We can only go one high in their rail car and you can get one and a half in, so that you lose quite a bit of space. They kick like the dickens about that.

MR. SHENDELL: The point I am wondering about is the point from the warehouse to the distribution point.

MR. OLIVER: Over there?

MR. SHENDELL: Yes.

MR. OLIVER: It is very, very rare that they use the unit load from the warehouse to the user.

You might have a body of troops some place in Germany. It would be a very rare thing that you would ship them fifty cases of tomato puree in one shipment. Almost without exception the unit loads are broken down at the overseas depot.

MR. SHENDELL: At that point do they like it?

MR. OLIVER: Yes.

MR. SHENDELL: The people that are breaking it down?

MR. OLIVER: Yes; they like it. They like it. Yes, sir.

MR. J. M. VAN ORDEN (Matson Navigation Company): What becomes of this pallet once it is unloaded? Is it reuseable again?

MR. OLIVER: Yes; it is.

MR. VAN ORDEN: Is it returned to the States?

MR. OLIVER: No; not as yet. We haven't reached that point of saturation over there. We are shipping them knocked-down pallets, which are purchased —

MR. VAN ORDEN: Wooden?

MR. OLIVER: — in this country now. We are sending them to Europe in small quantities. As this unit-loading operation gathers momentum, that will be their supply of pallets; but, of course, you have to look forward eventually to the fact that they are going to have enough pallets, and whether or not it will then become economical to ship them back for reuse, I don't know.

Our observation has been that there is a considerable amount of damage. I would say at least a third of the pallets need some repair when they get to the depot on the other side.

Now, that is probably largely due to the type of pallet we are using. We are using a pallet, standard military

pallet, which has the four blocks and, as far as we can see, it is those blocks that present the weakness.

One big reason is this: When you have unit loads that arrive at, we will say, the port, it is hard to get the unloading to that rail car started. Sometines the stevedores will throw a rope or a chain around those blocks to draw the pallet over to the door, to draw the unit load over to the door. They get very rough handling.

We have experimented with another type of pallet, and it is a considerable improvement, I don't think it costs any more, where we use two-by-fours which are recessed to give us four-way entry. I don't think it costs any more, and it is considerably better.

One thing you don't anticipate when you think about this thing is that you notice when you watch them handling unit loads at ports and other transfer points, it is very rare the pallet comes down flat, the load base comes down flat. It is apt to come down much more often on one edge, and with those present blocks in there, that is a weakness, and on a lot of those one runner gets knocked off, so that you have a wobbly pallet.

So we have tried to redesign the pallet -- not as a storage pallet; not as a warehouse pallet, but as a load base for unit-load shipments, and I think it is a considerable improvement.

Yes, sir.

MR. GARLAND W. CLUTZ: (Chemical Corps): Do you glue your containers when you use steel strapping?

MR. OLIVER: We have tried that, of course. We have shipped a number not glued. If you don't glue, your boxes slip out. The strapping loosens up. It loosens up in spite of anything you can do.

When we formed these pallets in the depot, these unit loads in the depot, we put a considerable weight on top as we tensioned the straps. We tried to take out all of that cushion in the unit load, or as much out of it as we can; but since they are corrugated fibre board boxes, as the load is transported, they continue to flatten down so that your straps get loose. If your straps get loose, then your cases are going to slip out.

Yes, sir.

MR. BROWN: I believe you said the pallet's load was made up at the depot?

MR. OLIVER: That is right.

MR. BROWN: Not at the place of the manufacturer where the food comes from?

MR. OLIVER: That is right.

MR. BROWN: And it is not a commercial cargo shipment rather than an Army or military shipment?

MR. OLIVER: We haven't done anything as yet, although that has been, you might say, in the top drawer of our minds, to see what can be done to extending the unit loading of these supplies beyond the depot to the contractor, to the canner, to the manufacturer.

We are at the present time working up a specification which we hope soon to incorporate in invitations to bid, and we will at least find out one thing at first: We will find out how much it is going to cost, how much more it is going to cost.

It isn't as simple as it sounds, because, in the case of subsistence which, as I mentioned, is our chief item of supply, from the tonnage point of view, many of these canners are small people. They have a little cannery out in Indiana some place, and it runs for a couple of months out of the year. They don't have a loading platform. They don't have a fork-lift truck. They wouldn't be able to bid if we required them to load at this time.

MR. BROWN: I might comment on that.

We have tried in some similar invitations to bid, some time ago, on toilet paper and towels, a very similar item, to unitize. The first reaction we got from these companies with this alternate bid: they set up the price so high — about three times the cost of the disposable type pallet. However, somebody on the West Coast came up with a disposable pallet, disposable type pallet, for his own use. So, when he gets the bid, he makes savings, and the additional cost involved is nominal.

We figured we saved probably about one-third of the extra cost involved in the disposable type pallet on the unloading of the car, itself.

MR. OLIVER: Yes

MR. BROWN: Now, if we issue a lot of that stock, and we do, toilet paper and towels, by the unit load, we get another savings when we select the stock and set it out on the floor for shipping, and again when we put it on the interior; and if we deliver it to the military, like we do, they get an extra savings —

MR. OLIVER: That is right.

MR. BROWN: — when they receive it and put it in storage.

MR. OLIVER: That is right.

MR. BROWN: This other thing you talked about, with the small companies, is a problem. We believe we can solve that problem. Instead of this decentralized purchasing that GSA has had through regional offices, they have set up now a national buying office and on these bulky high-volume items, they talk about six-month term contracts.

There I believe we can really do something on the unitizing of shipments, because the manufacturer has got a potential, a six-month term contract of a hundred carloads of towels, and he won't mind going out and buying this special pallet —

MR. OLIVER: That is right.

MR. BROWN: — adding the cost, and eventually he would get benefits to himself in unloading as well as us.

MR. OLIVER: That is right.

MR. BROWN: So, we hope with this new concept of volume purchasing to get somewhere on unitizing.

MR. OLIVER: That is right.

Well, with those in the paper industry, you have just the opposite with canning. You have a few big people, and we have gotten quite a lot of our printing papers unit loaded. There is no difficulty at all in the paper industry, as far as we could see.

MR. BROWN: Some of them have a conveyor set up -- for instance, Scott -- that is a big outfit, but they have got a conveyorized setup -- which is tailor-made, and they don't like the concept; but still, when the industry, itself, demands it and the Government, or if we, the military, get together and set a common denominator, gradually you will get a little better reaction.

MR. OLIVER: Yes. There is no doubt about it.

MR. BROWN: You get the volume there to justify the additional work.

MR. OLIVER: Yes.

MR. BROWN: After all, we are paying them for it.

MR. OLIVER: That is right.

MR. BROWN: It would still be the old system.

MR. OLIVER: Yes.

If the large grocery wholesalers would insist upon unit loads, so that small canners would have to equip for it, of course, that would help a great deal; but if we did it without that support -- people like Heinz and Campbell could do this very easily for us, but it would immediately squeeze out from competition almost all of these small canners.

That is the way we see it now. We hope that picture is going to change, and undoubtedly it will when we get into it.

Mr. Greenlin.

MR. GREENLIN: At the risk of being repetitious, yesterday I heard a splendid talk by the captain of the Quartermaster Corps regarding this air drop. I thought it was one of the best talks of this whole series --

MR. OLIVER: Yes, sir.

MR. GREENLIN: -- because it called attention to the possible opportunity for a supply mission, a strategic mission, where the airborne industry is concerned, or, say, the airborne division.

Have you thought, or are you thinking, or were you thinking about a logistical palletizing unit whereby you drop

so much food, so much medicine, so much clothing, say, for a company, a regiment, a battalion?

MR. OLIVER: Just thinking.

MR. GREENLIN: You are thinking about that?

MR. OLIVER: Yes.

MR. GREENLIN: We have been thinking about it, too.

MR. OLIVER: Yes, sir. We are just thinking, but so far our unit loads — on this project I have been talking about, each unit load contains only one item. We do not even put peas and beans into the same unit load.

MR. GREENLIN: How do you handle the various items? I notice sometimes beans alone go in the pallet.

COLONEL HOWALD N. MAIDT (Research and Development Command, Fort Eustis, Virginia): I can answer your question. Continental Army Command is doing a lot of things.

MR. GREENLIN: Are they?

MR. TORMYSON: I would like to address a statement to the Colonel here, if I may. I think it would be interesting to most of the tech services if we could get some expression from the Continental Army Commanders of how far forward they can take what size and what weight package.

I think it would help our thinking immeasurably in measuring our procurement as to what items could and should or which items could not or should not be containerized to what height and weight, and so forth.

COLONEL MAIDT: If you are asking me to get that for you, I do not represent the Army Continental Command. I am with Army Research and Development, but I agree with you.

MR. TORMYSON: You are a neighbor, aren't you?

COLONEL MAIDT: I just happen to know of the other project.

MR. OLIVER: Yes, sir.

MR. GEORGE: This gluing of the containers on the pallet is something new to me. Just what type of glue or paste is it that is being used?

MR. OLIVER: This is a glue that was developed by the Navy on commercial contract with one of the leading manufacturers of adhesives, and I think it is commonly referred to as load-lock.

MR. HEINRICH: Load-lock.

MR. OLIVER: Load-lock. Somebody at the Navy knows more about it than I do.

Isn't that right?

MR. HEINRICH: Load-lock was World War II glue that was used.

MR. OLIVER: Yes.

MR. HEINRICH: However, recently we have worked with this same company in developing a better glue.

MR. OLIVER: I know it has been considerably improved over the World War II. You can do a lot of things with glue. You can make it almost talk by adding a little of this and a little of that.

This glue has this peculiarity: it has very great resistance to doing this, where the cases are slanted. It has practically very low resistance to doing this.

Now, it is an adhesive that has been developed particularly for this purpose. The World War II adhesive had one defect from our point of view, major defect, and that was it wasn't sufficiently tacky. It didn't set up quick enough, so that when we glued these cases into a unit load, and then we applied the straps, the cases would pop out like watermelon seeds. Any tension you put on it — the glue was like a lubricant, and the cases would slip and slide.

So, we were compelled first to glue the cases, put them back in storage and let them mature a couple of days, and then bring them out and strap them; but with this recent development which has been mentioned, the glue sets up very quickly, so that we can glue them and strap them just in one production line.

There is, I think, is there not, a specification, military specification, on that adhesive now, or are you preparing one?

MR. HEINRICH: I think there is.

MR. OLIVER: I think there is.

MR. HEINRICH: We put a report out on it.

MR. OLIVER: Yes. It is at least a year old, I would say; and, on account of the fact it releases very easily, you don't te. · the cases.

I might mention, if anybody is interested, it is still, as far as we have found, a little too tough for paper bags. It tears the outer ply of the paper bags, and that is the ply you have your markings on. So, we are not satisifed yet with using it for paper bags.

Thank you, gentlemen.

CHAIRMAN JOHNSTON: Thank you very much, Mr. Oliver.

Our last speaker is Mr. Akrep, from Bayonne, New Jersey.

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Mr. Joseph Akrep
Supply Research and Development Facility, Department of the Navy

The text of Mr. Akrep's paper was identical to that included in Panel A-2, entitled "Specialized Materials Handling Equipment Requirements." See page 305.

Discussion following Mr. Akrep's speech was as follows:

MR. GREENLIN: Are these figures shown in that book you showed us?

MR. AKREP: This book here?

MR. GREENLIN: Particularly the cylindrical figures.

MR. AKREP: This is a report on the cylindrical containers. That report, showing all the charts I have here, is available or will be available from the Department of Commerce, Office of Technical Services. I have the address here. You can get this report.

MR. GREENLIN: It would save me a lot of trouble at times. Do you have anything to do with the packing of the pallet material?

MR. AKREP: Pallet material itself?

MR. GREENLIN: Yes.

MR. AKREP: No, sir.

MR. GREENLIN: The knocked-down pallets, in other words.

MR. AKREP: No, sir.

What would you like to know about it?

MR. GREENLIN: Well, somebody devised a package whereby they put a lot of lumber together in both ends, and built a pallet, put a strap around it, and the railroads say those are set-up pallets. They just let those two pallets be the way they were and let somebody hit them over at the other end and nail them up. As long as they put those two pallets are there, they run into the mixed package rule.

MR. AKREP: I don't know anything about it.

MR. GREENLIN: I don't think that is up to you.

MR. AKREP: No.

MR. HEINRICH: I think I can contribute a little bit on that.

I know the Army on their stevedoring pallets has a specification where those pallets are knocked down for shipment. Now, the original specifications were intended for overseas use.

MR. GREENLIN: Yes.

MR. HEINRICH: However, due to some mix-up, they had been buying those for domestic use.

MR. GREENLIN: Somebody nailed one pallet on each end of the package. My gosh, you are stuck with twice the freight rate on it, if they send the guy over there some nails and let him nail those two pallets up himself --

MR. AKREP: I have these sample charts here, if anyone is interested. These are the charts we showed on the pallet pattern for rectangular containers.

CHAIRMAN JOHNSTON: Thank you very much, Mr. Akrep.

If there is nothing further, the conference is adjourned.

(The conference adjourned at three-thirty o'clock.)

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Afternoon Panel Session

Wednesday, October 12, 1955

Panel Session B-3 Wednesday PM Oct. 12, 1955

Weight and Cube Reduction

Mr. R. W. Sherk
Allison Division, General Motors, Aircraft Parts Manager

Gentlemen, first I'd like to tell you a little bit about the Allison Division, our products and our background in packaging.

Since 1939, Allison has built roughly 100,000 engines of various types for the Air Force and the Navy. These have been about 70,000 of the V-1710 engines — reciprocating piston type engines, and roughly, 30,000 jet and turbo-prop engines. During the past fifteen years while we were delivering these engines, we have packed and shipped some 500,000,000 spare parts and special tools for their support.

Our spares shipments today average about 700 to 1,000 tons per month, and they are shipped, generally, to the Air Force prime depots, but many shipments are also made to using activities all over the world.

I think our background and history in packaging probably parallels that of many of the other defense industries in the sense that our experience during the war taught us certain lessons. Due to the problems of material movement, storage and the quick and makeshift planning for storage, the premium was placed upon extreme protection — a lot of safety factor, in other words. Some people may describe that as being the heavy grease and heavy wood-box type of packing.

About 1952, or late 1951, our Government and the public in general insisted on greater attention to economy, and this program hit us directly at Allison, because in the expense of packaging parts for the services we were spending some 3-1/2 percent of our gross sales dollar for packaging. So, that the total expenditures were an important piece of money.

Looking, then, at our costs, our first approach was to make a comparison, if we could, with other experience in similar industries and on that basis we thought that we could prove that our costs were not out of line at all. In other words, 3-1/2 percent of gross sales, generally, in industry was a pretty favorable figure. Paralleling that at the same time, speaking also of 1952, the record of complaints, or difficulties with our packaging were very, very small. We had from the Air Force literally no "U.R.'s", unsatisfactory reports, and from our own field forces, very, very few complaints. So at that point, I think it might have been an easy thing to say that our packaging was good and there was no reason to change it.

However, we had the occasional complaint, or question, I might say, from the services about over-packing. A specific item might be called to our attention. There had been no difficulty with damage to the item, but there was a question raised about whether or not we were over-packaging. So, we decided to go further then with the analysis of cost for our methods and materials we were using. The approach first was to break down in great detail the types of material we were using and what we were using them for.

The first was a rather crude breakdown showing that for example, about 52% of our total material costs were expended on plywood, and roughly, 15% for V3C corrugated cardboard, about 6% for the telescoping setup box for small items.

At the same time, we saw, too, that we were using about 300,000 pounds of dunnage per year, and from one standpoint that would represent only waste space and waste labor and waste material cost.

Now these facts and others led to what we have called our Packaging Economy Program. To start with, we realized that we had in our packaging operation a number of people with 12 — 15 years of experience going clear back to the beginning of World War I, and we didn't think that we were drawing upon their experience as fully as we could. The first portion of the Packaging Economy Program, as we called it, was to be a program to encourage the use of their experience — experience of our old packaging people by pointing out what it was that the Air Force and the Navy wanted for cheaper packaging or effective packaging plus cube, plus weight.

This program started in about February, 1953, and in the first year, the savings amounted to about $65,000 in labor and material; about 367,000 pounds in shipping weight and 26,860 cubic feet in terms of the size of the packages.

Now there were many other angles that tied into the same program. For example, General Motors, as you know, has some 90 Divisions and each of these Divisions contribute their packaging ideas to a central service section in Detroit. We began to draw upon the ideas developed in the many commercial divisions of General Motors to test and develop these ideas and determine if they would have application to military packaging; in many cases they did. Incidentally, the bulletins prepared by the General Motors Service Section were then made available to the Air Force and to the Navy. That was one source of ideas, let's say.

It was about that time, then, that we found that our ability to test and evaluate new methods and new materials, and new equipment left something to be desired. So, it became necessary that we develop a Section in our Packaging Department capable of evaluating, through various types of tests, all the new equipment and new methods from various sources. Towards that end, we obtained the services of Professor Mark Fowler of Purdue University, who some of you know as being an authority in the field, and who has been very active, in cooperation with the Air Force and the Navy on Packaging Programs.

Fowler helped us to train our personnel in the areas of testing and programmed approaches to evaluation of material. At the same time, we enlisted the help of our field people. We have some 170 service representatives in the field who we have trained to report back to us on conditions of packaging — either over-packaging or damage to material, and the conditions of marking and so on. These people also help us to evaluate any new materials that may be shipped into the field on a test basis.

In addition to that, and certainly not the least important part of our Packaging Economy Program, the Air Force with their many fine depots and activities — the Navy at ASO, and through the various overhaul depots — have all fed ideas into what we might call a test "hopper."

The important thing was that everyone — our own people, the other General Motors Divisions, Purdue, the Air Force, the Navy, our suppliers, were all feeding in ideas. At some points they seemed to be so numerous that we couldn't absorb them. The priority on which these tests were made was based, generally, upon the potential savings that could be made either in dollars or weight or cube, so that given ten new materials, a quick and rough evaluation could be made of the potential savings and we could classify the testing to be done in order, according to priority based upon the number of dollars to be saved.

One of the most interesting reactions that we've had from our own people, has been a marked boost in morale, a deep interest not only from a monetary standpoint because of the rewards that they have received from suggestions, but also, an almost driving desire to make Allison's packaging reputation better.

During the period that I talked about, from let's say early 1952 until the present, our packaging costs, department labor, without burden but including the light, heat, rent, supervision and so on, and straight material costs — our costs have been dropped down about 35%. We think that the problem really ought to be analyzed from the standpoint of the advance in development of new equipment such as engines and aircraft, and we feel rather strongly that up until fairly recently, the packaging design concept and the approach to packaging has been far behind the development of new equipment. We are very hopeful, and we feel confident that with the present program, and with the greatly increased interest of top management, both in industry and in Air Force and Navy, that we can accelerate the rate of improvement on packaging through the means that I have just described to you.

MR. PAUL F. CURTIS (Air Materiel Command): We will have a discussion following each paper. If you have a question, or something to contribute, please identify yourself with your name and your company.

MR. R. S. HOWARD (Sandia Corporation): Specifically, what improvements were made to give you this 35% savings in general?

MR. SHERK: Well, in general, the greatest savings were made in the area of taking material out of plywood and preparing lighter and much cheaper packs with VC3 cardboard. That was the biggest single area of savings. Perhaps the second was the fact that we learned that in attempting to confine the number of shipping containers to a small number, we were wasting cube by not designing containers to the specific outside dimensions of the parts. Now, perhaps I should mention that at Allison we are a job lot, small run operation. In other words, we run anywhere from 2,000 to about 7,000 items per month, so that we have no long runs. We are not able to put in automation or machinery for most of our parts. But, we did find, as a second point in this savings program, that in our attempt to keep the number of VC3 carton sizes to a minimum — we were wasting a great deal of cube. That was borne out by our figures on the use of dunnage, and by actual checks on many items. But I think those two areas accounted for most of the savings.

MR. PRESS (Curtiss Wright): I wonder if you can tell us something about how you are organized for this planning reduction.

MR. SHERK: Yes. I don't have any means of making an organization chart. However, briefly, the Parts Department reports to the Sales Manager. Now under the Parts Manager we have the Technical and Sales Section, the Order and Schedules Section, the Field Liaison, or Expediting Section who are responsible for the field people and the Packaging group.

I think you are most interested, perhaps, in the Packaging operation, itself. We have about 120 hourly people, supervised by a floor foreman and one general foreman. We have the single Packaging Technician and a Packaging Superintendent. We — I mentioned Mr. Mark Fowler — Professor Mark Fowler of Purdue — he is classed as a consultant, in the area of Packaging Improvement and Analyses of new materials and methods.

We draw very largely on GM Research — on the Laboratories at Wright Field, for certain testing...On Forest Products Laboratories. A lot of our testing is done by actual field shipment. In some cases, local suppliers have test equipment capable of performing tests within the range of Air Force requirements. But, we do not have, and I think this may be what you had in mind, we do not have a large research staff because we don't find it necessary.

MR. PRESS: Do you have a Packaging Engineering Section?

MR. SHERK: No, we do not. We haven't found it necessary to have a Packaging Engineering Section. In some cases our Standards Department might be classed as that type of an operation, but the cases are rather few and far between when we draw on their facilities. That is usually a case for material handling, or conveyorizing certain operations, but we do not class that as a Packaging Engineering problem.

MR. PRESS: Who do you have design your pack? Do you do your own, or does Supply handle it?

MR. SHERK: Well, this may come as a surprise. As a matter of fact, I've been with Allison only about 3-1/2 years and it was rather surprising to me to learn that by precedent and by good experience, we have found that a small group of four hourly employees are very capable of designing our package.

Do you have a question?

MR. NOBEL (ASO): Your costs shown here, of course, are the initial cost savings. Now, do you take any consideration on certain repairable items — it might be more economical to your customer — to pay more for the container and get a re-usable container?

MR. SHERK: That's a very good point, Mr. Nobel, and we, of course, certainly do that. Where the item is repairable the prime depot is usually contacted to make sure that the pack is such that can be used as a returnable container. Without doing that, these savings would mean nothing. In other words, if we shipped a repairable item into the field and the Air Force then, or the Navy, was forced to design and provide a returnable type container, these savings would be without any meaning.

MR. BASFORD (Bell Air craft): You mentioned that most of your savings were in package versus your cartons. Did you have your own carton-making machines, or do you buy them?

MR. SHERK: No, we do not have our own carton-making machine. We buy them from three different sources. In some cases there are four. But, we have analyzed the carton-machine economics rather carefully with the help of the General Motors Service Section in Detroit, and using the experience of several manufacturers who've used the carton-machinery, and find it to be not applicable to our short-run, job lot type of operation.

MR. SHERK: Dave, do you have a question?

MR. NUNN (Lockheed, Burbank): Did I understand correctly, you had four hourly people who are in your Package Development Program?

MR. SHERK: They are the people who design the original pack on any new item, working to boundary lines and rules that have been laid down within the limits of the specifications.

I think that may be rather unusual, Dave, but we find it to be so effective that we see no reason to change and hire Packaging Engineers to do the same job.

MR. NUNN: We'll join hands on that one, Bob. I think we are organized pretty much along the same lines. We do have some technicians. But, did I understand that you had a salaried technician?

MR. SHERK: Yes, we have.

MR. NUNN: Assigned full time, to more or less control the activity of the hourly people, and specification interpretation? What is his job?

MR. SHERK: Specifically, his job is the analysis and evaluation of new ideas and new methods — evaluation of the suggestions that come in. He will work with our Time Studies Group and with our Suggestion Department to definitely pinpoint the savings that can be made, because suggestions are paid off on the basis of two months — the award is based on two months of the savings.

In other words, if you have a $1,000 savings for th year, 1/6th of that would be the amount of the award, so that it is necessary that the savings be analyzed ve..y thoroughly and it is his job, then, to coordinate the analysis of any new ideas, whether they be for equipment or material, methods, based on the suggestion.

MR. WILLIAMS (Sandia): I've seen a good many permanent type containers used for packaging jet engines, complete engines — And I assume from your remarks that you don't provide that packaging?

MR. SHERK: Well, I'll have to explain a little further about our organizational set-up — the packaging of the end product. The engine itself, or in some cases the power section of the turbo-prop engine, or the gear box of the turbo-prop engine, is a separate organizational function. It is handled by the manufacturing sections, and in the remarks I've made here today, I should have made it clear that they do not apply to the packaging of the end item.

The steel containers and engine cans are really a separate problem. I'm talking here of spare parts and special tools and equipment.

Panel Session B-3 Wednesday PM Oct. 12, 1955

Weight and Cube Reduction

Mr. H. M. Lapidus
Head of the Technical Section of the Preservation and Packaging Branch
Bureau of Supplies and Accounts, Department of the Navy

The subject of my discussion this afternoon has to do with the procurement aspects of weight and cube reduction, bearing in mind, of course, that I am looking at it from a Government point of view.

In reducing the size and weight of military shipments — in order to "stretch" the transportation and packaging dollar — one of the more difficult problems confronting the military services involves the area of new procurement entering the military supply systems.

A large majority of the materials shipped by military activities utilize containers in which the material was originally received from contractors.

Experience over the past three years within the military establishment has shown that it has been possible to reduce the original tare weight of this new procurement by as much as 30%, and in some cases, a great deal more, without sacrificing requirements for physical or mechanical protection.

In terms of cube, this weight reduction of 30% has meant a "companion" overall space reduction of 40%. At several of the largest military shipping establishments, it has been possible to cut the gross average tare weight of shipments in half without any significant increase in damage as verified by thorough loss and damage analysis. Naturally, savings in weight and cube have been accompanied by important economies — not only in transportation, but in packaging and handling as well.

Two of the military departments are already talking about combined savings of over 7 million dollars in transportation and packaging costs. There is reason to believe that much of this was achieved, and is being achieved, by the efforts to control or reduce the size and weight of shipments.

It is significant to note at this point, that while all this "reducing" has been going on, many actions have also been taken to increase weight, where necessary to afford adequate protection. In some cases, it has been possible to achieve greater protection without materially increasing weight or size.

What do all these savings indicate? Does it mean that all new procurement is grossly over-packed? The answer is definitely, "No!" Except for shipments destined for "immediate use" and those earmarked for specific programs or projects, the ultimate transportation handling and storage conditions to which military shipments will be subjected after initial receipt by the supply systems cannot be predicted with certainty at the time of procurement. As a result, new procurement entering the supply systems for storage and possibly overseas shipment, are afforded certain general levels of protection.

After materials have entered the supply systems, it is both necessary and desirable to re-evaluate the original level of protection to determine whether it is now consistent with new conditions which, in most cases, are better defined either as to mode of transport, type of distribution, end use, storage conditions -- or a combination of these. Both "underpacking" and "overpacking" are distinct possibilities. But in dealing with "overpacking" it is important to determine: (a) that requirements for protection are not sacrificed needlessly and (b) that worthwhile economies can be achieved by actions to repack or in some few cases to unpack.

On the face of it, it would seem highly advantageous and desirable for suppliers to ship packages and shipping containers of the smallest size and weight permitted by their contracts. However, evidence of considerable quantities of envelopes, cans, cartons and shipping containers with less than 50% of the internal void taken up by the articles and a large percentage of the balance taken up by stuffing materials or bracing to restrict movement as distinguished from cushioning which affords physical protection — quickly dispels this notion. In dealing with this problem, we must first examine the ways in which transportation costs for new procurement are paid for by the military agencies.

Generally speaking, F.O.B. Destination shipments are made on commercial bills of lading which are paid for by the contractor. In formal advertised bidding, F.O.B. Destination means that transportation costs, based on the weight and sometimes the size of the shipment, are competitive factors in bid evaluation and subsequent award. Under this circumstance, excessive weight (or size) is less likely to be a problem for the Government for very obvious reasons. That is, in order to be competitive, the contractor must give very detailed consideration to the size and weight of his shipments, because he is paying the freight bill.

However, F.O.B. origin shipments are generally shipped on Government Bills of Lading. Under this arrangement, the articles are accepted by the Government at source and are shipped on Government Bills of Lading, with the Government paying the transportation charges. The matter of weight and size of packages or shipping containers is not therefore a matter of contractual concern for the supplier unless maximum or specific weights or sizes are stipulated by the contract.

Please note the expression, "a matter of contractual concern." The reason for highlighting this, is to acknowledge the conscientious role played by many suppliers in demonstrating their awareness of size and weight conservation, despite the absence of contractual restrictions. A mere indication of "intent" by government negotiators has been sufficient on many occasions to obtain desired results. However, the tendency to use packages or shipping containers which are larger or heavier than necessary still prevails for reasons of convenience, initial cost and possibly other factors.

A hasty glance at Federal and Military Specifications discloses the wide latitude afforded suppliers in selecting package and container sizes and types — and perhaps for valid reasons. This demonstrates, however, that this tendency of "convenience" cannot always be laid at the door of the supplier.

Three solutions for this problem are offered for your consideration:

(1) The establishment of maximum weight or size restrictions in procurement documents, where practicable to do so.

(2) On bids involving shipment by Government Bill of Lading, consider the weight and size of shipments in bid evaluations and subsequent awards, and

(3) Examine Federal and Military Specifications to determine what, if anything, can be done to restrict the weight and size of shipments to an adequate minimum without jeopardizing the bid potential on the articles themselves.

Thank you very much.

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Mr. H. M. Lapidus
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MR. JOHNSON (Pratt & Whitney Aircraft): First, do you have in mind any relation of gross cube to net cube as a means of packaging efficiency? An item like that could be used in talking about wasted space, for instance, with blocking and bracing. Do you have a chance to compare the cubage of the part itself with the gross cube of the container as a measure of the effectiveness of the package? Is there anything that has been done to use that as a measure?

MR. LAPIDUS: Do you mean something that might be used as a "rule of thumb" as applied to specific items?

MR. JOHNSON: Yes.

MR. LAPIDUS: No. I can't give you that because of the variables involved such as the characteristics of the products, the space they require for movement and the cushioning that is used. There are so many factors that enter into it. I think the only hope is for more detailed attention from the specific design engineers in keeping this weight and size problem close at hand as a factor in working out their designs.

I'm going to get ar[illegible] o something, however, that we found in our numerous s[illegible] on this subject. By examining our own operations we f[illegible] that tare weight expressed as a percentage of gross weight came out about 35% of gross weight. As a result of intensive effort in this field it was possible to reduce that 35% a considerable degree. The reduction varied somewhat with the type of material, which bears out the point that I made to begin with.

MR. JOHNSON: In starting a program of this sort, you must have some basis for working toward the reduction of tare. In other words, where do you feel that the break-off point is, where tare weight is excessive weight?

MR. LAPIDUS: You must have break-even points established, and that was a definite part of the program. For example, when shipments are going by air, you've got to take into consideration the rates and the miles, and so forth. In some shipments it just didn't pay to do anything. In other cases, where you have premium transportation involved over long distances, it definitely paid to do something about it. Each activity worked out a break-even arrangement.

In our Navy experience, for every dollar invested in repacking, based on the break-even points established, we got about $12.00 back in transportation and packing expenses. I think this is a pretty good return on the money.

MR. NOBEL (ASO): In answer to Johnson, one criteria that we found, is to take a look at the item and see if it has been disassembled to its greatest possible extent without requiring extra tools and skills to put it together before you use it. In the case of one aircraft wing, where the crate was about 30 feet long. we were able to reduce it by 4 feet. The crate weighed about 100 pounds per lineal foot so that 3 feet, of course, represented 300 pounds and a considerable amount in cube.

MR. LAPIDUS: Too often we seem to give the impression that the only way of saving weight and cube is by either repacking or unpacking and I'd like to emphasize this right now — that even though we've made our major savings in that area, we are frank to admit that this is the least desirable way of achieving tare weight and cube reductions. We'd far prefer to see more progress in the procurement end of things and dispense with this need for repacking or unpacking.

MR. DE MEO: Would you consider in the case of DT tools, such as cradles, tow bars, hoisting slings — that you discontinue the packs that go to open crates rather than fully sheathed crates in the interest of saving weight and cube?

MR. LAPIDUS: I don't want to hedge on that question, but while we have a great interest in reducing tare weight and cube, there may be many other things that influence such decisions, and I wouldn't want to give you a wrong impression. From the standpoint of weight and cube reduction, yes we would favor that they go in open crates in preference to fully sheathed. On the other hand, you have contractual relations with the Aviation Supply Office and the Air Force. For very valid reasons they may not agree to the concept of open crates. They may have certain storage conditions to which these things might ultimately be subjected — be held for long term arrangements of one kind or another — and I just don't know what the reasons would be, but I'd like to get Joe Nobel's comment on that........

MR. NOBEL: Many of these big items have to be stored outside so that the crate is not only a medium for shipping, it is also a platform and they may want to store on top of it. We also reship it quite often. If you feel that you have any items that can stand out in the rain for a year, or so........

MR. DE MEO: (Interposing) The only reason I asked the question -- and I probably asked for this, actually -- after they handle it -- toss it around -- that's the impression I get -- do we need to go through the elaborate packaging procedure that we are today. Now you take a tail section dolly -- That container will be about 11 foot long plus the fact that it is square. It's very heavy.........

MR. LAPIDUS: (Interposing) That's true, but of course, but even in the tare weight and cube reduction program you've got to bear in mind the various factors that influence handling. Storage, stacking, superimposed loads, possible outdoor weathering, and the general distribution pattern for the particular item must be considered.

On some items, the answer might be a definite "yes," and on similar items, you could get a reverberating "no." It is a matter for individual examination by the cognizant contractual agency such as ASO and the Air Force, in the case of your plant. I certainly feel that they will be more than happy to give full consideration to any ideas along that line.

MR. OVERSTAKE (Air Force): Maybe Navy is a little bit different from the Air Force. We apparently have a shorter pipeline and less variance in the program. I employ the test equipment that Mr. De Meo referred to, and we feel that once we get it in the system, it's going into use. This particular test equipment had very limited procurement. We feel that we don't have any storage problem.

Now you have some returns of your reparable items that you have to repack, but normally speaking, test equipment and most of our high valued costly spares, are considered to go out in the field and into use. Not too much storage involved.

MR. LAPIDUS: As an ex-Air Force Supply Officer, and one in training now, and having been exposed to the problems of the Navy Aeronautical arm, I can see very clearly why the Air Force can probably generalize on a very positive "yes" to that question, and I can see where the Navy could have some hesitation about accepting it for pretty valid reasons.

MR. KADDIK: (Dumont) I think the reason that the gentlemen gave for using one-inch sheathing to reduce the occasion pilferage is rather weak because the experienced crook, shall we call them, will carry appropriate tools for that. If he is interested in avoiding pilferage he could use a good press-board, or heavy mullen pressed fiber board, or something of that nature, to conceal what is within the crate.

MR. NUNN (Lockheed, Burbank): Could I ask, Herb, if you would reiterate, or clarify, your statement about the reduction, as I understood, of suppliers' tare by up to 50% without increasing loss through damaging. Now, I guess this is a two-part question: were these excesses violations by supplier on the heavy side going beyond the spec requirements, or were spec requirements relaxed in order to achieve reduction; and secondly, if the latter, does it suggest that performance requirements of the various specs that we are working to, are somewhat arbitrary and you are currently studying them to relax, or relieve those........

MR. LAPIDUS: (Interposing) Let me get that last question first. The performance requirements are, or will be, in the very near future subjected to some very serious scrutiny for many of the reasons that have come up in this discussion. I don't want to go further into detail on that because the three Departments at the present time, are holding discussions on this very aspect, and it would be premature for me to talk about it.

Now, the first part of that question was, "Did they operate within the limitations of the contract, and so on?" I would say for the most part they did. That is the unfortunate part of the whole thing. When we went back to our government inspectors and questioned the wisdom of releasing shipments of this kind, they were quick to tell us that there was no valid basis in these contracts for rejecting the suppliers' shipments even though it was obviously a waste of space and weight and a complete disregard of handling, warehouse or anything else.

MR. NOBEL: We distribute about 475 thousand different items ranging from a rivet to almost a complete airplane. The biggest weight and cube "wasters" for want of a better word — I hope my friends will forgive me — are my industrial colleagues. They invariably come in and say, "We want to standardize on, let's say, 10 sizes of boxes," and there's a great advantage in that — but by so doing — and as long as industry keeps that up — the weight and cube program is going to suffer because somewhere in between these 10 there are many other increments which industry won't buy — in fact, I would like to hear from the Pratt-Whitney representative on that.

MR. LAPIDUS: Perhaps we shouldn't put him on the spot like that, but it would be interesting to get an industry view because quite often the standardization of containers has gotten us into difficulties as far as the over-all efforts on weight and cube reductions are concerned.

MR. JOHNSON: Our attempt at standardization has been limited to a point of attempting to set up maximum clearances around a given part in a container; and specifically speaking of the larger parts of an aircraft engine, whether it would be a jet or a reciprocating engine or the larger subassemblies, where it would make some sense to — where we have the same problem as Mr. Sherk in that while you are making a heck of a lot of different parts no one of them has large volume production. And in an effort to keep container costs from being too specialized, buying 10 and 25 at a time, we have attempted to standardize to the point of allowing, I believe, a — oh, a couple of inches all around a part as a maximum, with an optimum condition of 1-3/4 of an inch if we've got it well tied down. But we haven't gotten to the point of using 10 containers for every spare part.

MR. LAPIDUS: I am sure you realize, as we all do here, that you can buy an awful lot of standardization in this respect at the expense of a lot of other things.

MR. JOHNSON: That's right.

MR. LAPIDUS: For example, you could standardize on a limited number of containers, but what you would be doing then is adding to the cost later on for warehousing, handling, special transportation, and all the other things that go on, added weight and so forth——

MR. JOHNSON: (Interposing) I am very frank to admit that this meeting has done a lot to enlighten me on things of that nature.

MR. LAPIDUS: Standardization of containers — that is when there are too few sizes — creates a real problem because we have had a lot of void. Sometimes these standardized sizes have not been in consonance with the best efficiency on the standard 40 x 48 pallets that we use. In a very short time the Naval Supply Research and Development Facility at Bayonne will issue a report that has to do with the selection of container sizes. I think that it will influence the thinking of a lot of people in just what sizes they select. Behind you, there, I see Mr. Grayman of the Clothing Supply Office in Brooklyn. Their program started, actually, with that same kind of a concept. They started with the pallet size and went back into full standard and half standard, quarter size containers and then began to fill those containers up with clothing items. Well, of course the quantity and the circumstances there enabled them to do that

kind of program; but it's not applicable to the type of production shipping you do in a plant like Pratt-Whitney. So each one has got to moderate it to his own particular problem.

Mr. P. F. Curtis
Chief, Packaging Branch, Air Materiel Command, Department of the Air Force

I must agree with Herb Lapidus that it is most desirable for us to get containers into the system that have minimum weight and cube. My paper is dealing with a depot operation — what we are doing internally — because we don't always have packages with that most desired minimum weight and cube. We in the Air Force, as well as the other services, are interested in airlift. We are using considerable air freight for moving priority items, and also our high value items. That is going to be my theme.

Many problems are encountered in our endeavor to achieve economies in packaging materials, warehousing, and transportation by reduction of tare weight and cube of packages and shipping containers, during the preparation of military supplies for shipment and storage. It is my intent to present briefly two of these problems, plus the procedures and methods developed by the Air Force to overcome them. They are (1) the predetermination of mode of transportation prior to packing and (2) the shipment at minimum expense of large fragile articles of unusual nature and value.

To accomplish monetary and material savings by the reduction of tare weight and cube of containers, it is fundamental that the packer on the packing line knows how we are going to move the shipment. This advance information is necessary to insure the use of the lightest weight packaging materials and containers consistent with the anticipated hazards of the mode of transportation involved.

The Air Materiel Command prepares and ships approximately 90 percent of the total supplies for the Air Force. Within AMC, procedures have been established to determine which cargo is to move by air and which cargo is to move by surface means. Prior to the time requisitions are processed by the Materiel Control Division of the installation, they are screened by the Traffic Movement Control Activity to make this determination. This is dependent upon a number of factors, such as whether they are Hi-Value items, Critical items, Aircraft Engines, or items destined overseas carrying high supply priorities. If the items fall into any of these categories they are assigned air priorities and moved by air transportation. The mode of transportation is then noted on the requisition. When the requisition is received at the warehouse and air transportation is specified, the storekeeper selects those items already packed for air shipment

or immediate use, if they are in stock in such condition; otherwise, he pulls the item as packed and forwards it to the packing line for the stripping down and repacking, as necessary.

The packer notes the mode of transportation prescribed and packs accordingly. In the case of air shipment he has guide lines for packing in the form of our technical order 00-85-9, and a container selection chart, and specification MIL-A-25175, also we have these two computers. The container selection chart is designed to serve as a guide to lead the packer to the exterior containers for air shipment that will furnish adequate protection with the least possible tare weight and cube. In contrast to surface carriers, the weight carrying capacity of aircraft is generally reached before the cargo compartment is filled. Consequently, minimum container tare weight is a most important factor. The characteristics of the item to be packed, together with the limits of the container, must be considered. If the choice lies between two or more containers, naturally the one with the lowest tare weight will be selected. As an aid, the packer has a computer to estimate the tare weight of a container based on container materials used and the size of the container. In the event the item is already packed for surface shipment when it arrives at the packing line from the warehouse, we have another computer which helps the packer to determine whether it is economical to strip down or repack for air transportation. This guide is composed of three calibrations: tare weight saved in pounds; man-minutes required to strip or repack; and the destination distance. The guide also contains a chart for determining the number of miles between various Air Force installations and bases.

This procedure of predetermining the mode of transportation prior to packing has resulted in substantial savings. As an example, at one of our Air Materiel Areas during the period 1 April 1954 to 30 April 1955, 17 million pounds of material were shipped by air. The total weight saved on these shipments was calculated at 4 and 1 quarter million pounds or 20%. This was accomplished through the use of paper overlaid veneers in lieu of plywood, flex pac in lieu of wood blocking, V-board containers in place of metal containers, open crates in lieu of sheathed crates, et cetera. The calculated total savings in packing was $152,259. The total savings in transportation costs were approximately $2,278,300, for a grand total savings of 2-1/2 million dollars. These are the results of only one of the AMA's, of course, it's one of our active installations — it ships a lot of material — but when we multiply that by the other

14 we have in the system and, if we get the same benefits from the procedure, we will save lots of money.

Another problem to be considered in container weight reduction and handling simplification efforts is the shipment of large fragile articles of unusual nature and value. Excellent examples of these articles are trainers, engine accessory test equipment, flight simulators, ground electronics equipment, et cetera. The Air Force has a regulation which permits the shipment of this type of article uncrated by authorized carriers having proper operating certificates for the transportation of fragile items of unusual nature and value, and possessing special handling equipment and protective blocking and cushioning devices. Certain conditions must be known, of course, to exist before this type of shipment is authorized. They are:

(1) The items are of such nature as to require extensive disassembly and packing if prepared for shipment by other modes of transportation.

(2) The items are destined for immediate installation at destinations where adequate facilities are available for care and handling during the period of temporary storage.

(3) The cost of packing and shipping by other means would exceed the cost of preparing, shipping, and handling uncrated items in authorized rail, motor, or air carriers.

In the case of Trainers, one type we studied cost us about $2,300 to crate. Although the transportation rates of approved carriers are higher than rates of other common carriers, when the requirements of the aforementioned criteria are met, substantial savings may be realized by utilizing such premium transportation. In one instance it was estimated that a savings of over one million dollars was realized by making uncrated shipments of 389 Trainers and 151 pieces of test equipment. This concept today is being applied through out the Air Force.

Now, in any program to accomplish savings by the reduction of tare weight and cube of containers, many other factors too numerous to mention here must be considered. The problems outlined above are some that have been encountered and resolved by us.

Mr. P. F. Curtis
Panel Session B-3

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In connection with the computers which I mentioned earlier, we got the cart before the horse; we came out with a computer which, for example, to repack it, any time we shipped it by air more than 600 miles, we started to make money; that's all very good. But we had failed to provide for telling how much the box weighed — the difference between the two boxes. So we had this computer developed. Now, this is just a prototype which Forest Products Laboratory worked up for us. They wanted me to be sure to emphasize that this is a little rough at the moment — but there will be some refinement before we come out with the finished product.

Considered on this first chart are several types of containers, 3/20" plywood, 3/16" overlaid veneer, nailed wood boxes of 7/16" boards, 9/16" and 25/32", wire bounds, and V-board. So, the example is, if I have a wood box that is constructed of 7/16" resawed lumber, and it has a dimension of 25 by 20 by 15 inches, I use three scales with the arrow coming to each of the three dimensions; then the ratio between 7/16" wood box and the fibreboard box is 4. By setting my scale here I come up with a 4 — if any of you would care to look — and I have saved 20 pounds plus by removing it from the nailed wood box and putting it in the fibreboard box. Therefore, if I saved 20 pounds as I have, and it took me a half hour to do it, any time I move it by air more than 600 miles I start making money by taking the old pack off and putting on the new one.

VOICE: Are those things available?

MR. CURTIS: These are not available, as yet, even to us; this is a cardboard prototype that Ken Kruger sent down because I was so anxious to use it here. But I am sure that an inquiry to the attention of Mr. Kruger, Forest Products Laboratory, Madison, Wisconsin, will get you the information.

MR. BASFORD: What is the name of that chart?

MR. CURTIS: Well, this one is titled, The Air Freight Guide for determining when to strip or repack items shipped by air.

MR. OVERSTAKE: Paul, doesn't that one have a stock number on there where it could be gotten out of Air Force Class 25 or 30?

MR. CURTIS: (interposing) That's right, they are available to our installations. But since we are not in the business of manufacturing computers, I am not sure what I would run into getting them outside the Air Force. However, if there is any clearance needed, Forest Products is willing to have these made for us. If there is any clearance needed from us, we will give it to Forest Products.

MR. NOBEL: I am just going to ask you one question. In taking off all your packing — I know you made a great initial saving with air shipments, but do you give consideration to the fact that the last 50 miles may go by ox cart? What was suitable by air may not be true for getting it from the airplane to the point of use?

MR. CURTIS: We recognize there's a possibility that that is going to happen, but we are not going to pack air shipments the same as vessel shipments just because there is a possibility of a 40 or 50 mile surface haul overseas. Therefore, we have sent to all the overseas theaters instructions that certain priorities, those are the ones that will move by air, are going to be packed for air transportation. At their terminal, if the condition of shipment or mode of transportation changes, it's up to them to set the facilities up within that terminal to get them in another box or do whatever might be necessary to reinforce the container they are in. I don't know how we could ever justify packing for that toughest mode of transportation and use air.

MR. NOBEL: No; I am thinking in terms only of the reusable items which are shipped back to your repair depots — like we have O&R's.

MR. CURTIS: If they come in these high value items such as engines, or any of the others, which the Air Force has classified to be a high value, the return would be by premium transportation also, Joe, because the plan within the Air Force is that these items will keep moving — but fast. We will not ship an engine overseas on a dolly, for example, and then tell them, "You return it by slow boat." If it has to come back to a maintenance shop in the States, he will return it on the dolly.

MR. NOBLE: Do you know right now whether or not you have a backlog in the maintenance program; or are you so caught up that as soon as they come back?

MR. OVERSTAKE: Could I add to that? We have the same reparable system overseas we have here. They are doing the same amount of work we are doing and the same area of value. Very few of our assemblies are necessary to come back. Now, on the engine program they do; we ship by air and we get back the reparable. But in the wheel and brake field, struts, electrical — a lot of it goes through our control depots in the overseas area and back in supply stocks.

As far as the ox cart, we can get our helicopters down on air pads in places you can't get this ox cart you referred to. So we don't have any problems. And as we do have problems, then we get coordination with what the problem might be and we will pack them to take care of the truck shipment on the tail end. In other words, try to come up with a universal pack and still cut weight and cube.

MR. CURTIS: Last week we had a little packaging show out at Topeka, Kansas. Lieutenant Colonel Davies was in from Japan. To handle the items that I am talking about, they have airlift; or if they do not, they are not turning these items over to Japanese carriers. They are providing military trucks and giving them the handling that they deserve to get them that last 50 miles. In Europe we have set up Logair to provide air shipment. Recognizing that there will be instances when a truck will haul the item the last 50 miles, the instructions I previously mentioned as being issued to the European Commands will apply.

MR. SHERK: Paul, I would like to make a comment from the standpoint of an engine manufacturer — in respect particularly to Joe Nobel's comment about reparables and reparable items. I think we have experimented with steel containers -- steel drum containers for rolls and pin wheels and compressor rotors, which are perhaps the most — the fastest moving of the engine components; and in line with the over-all trend of the conversation here today, it would seem to me that the Air Force, maybe, could afford to look at more expensive aluminum or possibly magnesium containers for that type of item — for the weight and cube savings. When you have an item that goes out to an operating activity and comes back in to the overhaul activity; and may travel back and forth during its life ten times, you can, I believe, afford to go into a more carefully designed lightweight container which will still provide the stacking ability, the low cube, the low weight that you require for air transportation.

MR. NOBEL: We have done that, you know; practically the whole helicopter industry ships their reparable items for the Air Force and the Navy in aluminum.

MR. SHERK: I see a few airframe items; and we are experimenting — doing some work on engine parts; but I do think that in general your engine parts are faster moving.

MR. NOBEL: We have seven or eight major overhaul and repair shops. They each employ at least 5,000 people. As high as 25% of their labor and materials goes into repairing damage to reparable items, which were not damaged because they were used, but because of transportation and handling. Because of this we like to ship these high cost items in reusable metal containers which require no material — or for that matter no skill to ship the stuff back. It would seem to me that in trying to take advantage of the recognized advantages of air shipment you might lose sight of — what I have just said — in other words, you might increase your damage.

MR. OVERSTAKE: In the area of instruments, we consider that metal containers are the universal pack. Now, granted, in the future we should cut back to magnesium or lighter material — but the big cut back is in airfoils and wings. We still put great emphasis on packing for physical and mechanical testing — the only thing we don't do is put a plywood housing on to them. We let the aircraft people see what they are handling, and we give them a good skid to handle it by. There is no thinking of cutting back beyond what it takes to physically protect; the only thing we are not doing is putting that house on it.

We would ship wings by taking them out of the can and putting them in the shell; or, in the case of struts, we only skid them.

MR. NOBEL: Of course, we still have to move a few things by ship——

MR. CURTIS: Well, believe me, we do too. We believe that approximately 80% of our tonnage is surface movement. But what we are getting into, Joe, is what the Supply people have called high value items which we want to get there quickly and get them in use quickly, and get the reparable repaired as soon as possible; those are the ones we are talking about — those on priority.

Lieutenant Klingenberg
Materiels Laboratory, Wright Air Development Center
Dayton, Ohio, Department of the Air Force

To properly package a relatively fragile item, three factors must be known: (1) the service conditions under which the pack will be handled in the field, (2) the performance characteristics of the cushioning or shock isolation system utilized for shock protection, and (3) the fragility or ruggedness of the item.

Since one of the purposes of this particular conference is to discuss the problems of reduction of weight and cube of containers, it was considered that a discussion of the above factors with special emphasis on fragility would be of interest. An effort will therefore be made to indicate some of the problems and developments of each of these factors.

The first one is SERVICE CONDITIONS. The service conditions under which a container will be handled are incorporated in the rough handling requirements of the various item specifications. The height of drop requirements used by the packaging engineer for designing a cushioning or shock isolation system are readily available from the item specification. The standard for most of our present rough handling requirements is military Specification MIL-P-116. However, since this specification was written primarily for methods of preservation, a new specification, MIL-P-6200 (USAF), has been initiated and is ready for coordination. It will more clearly spell out rough handling requirements and alleviate some of the problems of the older spec. The new spec will change the rough handling requirement for heavier containers; the increments of weight with their corresponding increments in height of drop will be changed. It will benefit, essentially, the heavier containers. For example, for containers over 3,000 pounds, the cornerwise drop requirements will be decreased to a 12-inch drop. Some of the containers now are being dropped from 36 inches. This, therefore, is a relatively major change in the Air Force's requirements.

To obtain additional information on field handling conditions and to prove or disprove most of the present height of drop requirements, WADC is presently conducting an extensive service conditions project. The object of this project is to obtain statistical information of the severity of rough handling of various weights and sizes of containers that are shipped through Air Force supply channels throughout the world.

Each of our test containers will be instrumented so that the frequency and equivalent height of fall experience during handling can be determined. The project presently is well in its instrumentation development stage.

The second factor to be considered, CUSHIONING AND SHOCK ISOLATION SYSTEMS: Much information is currently available on the static energy absorption characteristics and design formulas for most cushioning materials. They indicate that optimum conditions for least container cube can only be obtained through the proper selection of material, density, and bearing area of the item. An analysis of our newer materials, such as the polyurethane and isocyanate foams, indicate that a lesser thickness of these materials will be required to do a specific cushioning job. Their optimum operating ranges, however, are much smaller than those of the less efficient materials. Take for example, our commonly used cellulose wadding, and curled hair, and one of these new foams; the operating range for curled hair is only one-third of that of cellulose wadding, and the isocyanate and polyurethane foams are only one-quarter. So, therefore, a more widespread knowledge of the engineering principles involved will have to be gained for proper utilization of these newer items.

A new Air Force Specification MIL-C-26861 is presently being circulated for coordination, which classifies all potential cushioning materials on their relative static energy absorption characteristics. This specification differs from our other regular cushioning specs since it does not specify any kind of material that must be employed. In other words, any material that can be used economically as a cushioning material no matter what it is made of will qualify under this new specification. Essentially it breaks the material down into five types: the first two types being cellulosic wadding; the third, fiberglass; the fourth, curled hair; and the fifth, the new isocyanates and polyurethane foams. This specification also includes a design table and design formulas in the notes section which should be relatively simple to use. As I understand, our depots have used a table such as this with our old Air Force fiberglass spec. It is believed that this specification will encourage the use of the lightest and most economical material available for a specific problem and also encourage the improvement of some of our present materials.

At this time we are also initiating a new project at WADC, to develop an inexpensive foamed inplace cushioning material. This material will be available both in a rigid and entirely

resilient form. The rigid form would have an application in air drop delivery cushioning; and the resilient form would be in our regular Air Force package shipped in our present system.

Although static information has aided the packaging engineer tremendously in the design of cushioning systems, it has been found in recent years that exact cushioning performance characteristics can only be obtained by some type of a dynamic test of the various materials. For this reason, tests are being conducted at North American Aviation, Forest Products Laboratory and WADC to obtain these characteristics. One of our talks yesterday was on the work that North American is doing on dynamic testing. High velocity impact tests for cushioning suitable for air drop delivery applications are also being conducted by the Quartermaster Corps at their own facility, Lowell Institute in Massachusetts, and University of Texas.

To further development of the shear mount, the Navy is conducting a project to establish the necessary requirements for that device. We have not as yet been able to determine on what requirement basis this specification will be written.

The third and probably the most important factor in this consideration, since we have the least information, is the FRAGILITY of the item being packaged. This factor was referred to in several talks in the last couple of days. The fragility of an article is usually defined by a magnitude of acceleration or deceleration which an item can safely withstand without malfunction. Some measurement of frequency or time duration of the shock impulse must also be included since each individually packaged item is constructed with different physical characteristics and has what we call varying natural frequencies. The frequency or length of impulse is important in the design of a shock isolation system since this system also has its own natural frequency. If the systems are not designed properly, resonance might be experienced with the resultant destruction of the item.

To illustrate the effect that a fragility rating has on the relative volume of a container, and also the corresponding weight, let us assume we are packaging an item one foot in cube and putting it in a curled hair pad. To limit this item to a 10g acceleration for a 30-inch drop, approximately 12 inches of hair would be required on all sides or a total volume of 27 cubic feet. If, however, the fragility rating of this item could be raised from 10 to 20g's, either through more accurate fragility information or a slight modification

of a fragile component on the item, the cushioning thickness could be reduced to 6 inches and the overall cube to only 8 cubic feet. In other words, a reduction of 70 percent in the original size of the container, and that is only for a change of from 10 to 20g in its fragility rating.

Several years ago, WADC attempted to collect information on the fragility ratings of various equipments with little success. It was found that this type of information is seldom known by the equipment manufacturers.

Fortunately, however, some work in this field has been initiated, with current emphasis on various electronic components. Although no standard fragility test has been established, certain apparently feasible test methods have either been tried or proposed.

One method utilizes a vibration machine to vibrate the component at increasing frequencies and acceleration levels until a malfunction occurs. Fragility information has been obtained by this method for relays, electronic tubes, resistors, transformers, potentiometers, fasteners and capacitors.

Another method utilizes a shock machine of varying acceleration levels and time durations. This machine can either be mechanically driven or be composed of a dropping table with a sand pit impacting surface. A klystron tube has been recently evaluated using a mechanical type shock machine.

A third proposed test method uses a series of calibrated cushions into which an item is dropped from varying heights. Aside from its apparent simplicity, this method imposes a shock wave similar to that experienced in actual cushioned container.

To illustrate the complexity of fragility testing problems, the results of a recent shock wave analysis project are of some interest. The project analyzed the effects of a shock wave of any wave form on the various resonating components of an item. It was found that a shock wave obtained during one of our standard equipment shock tests, although supposedly 30g's in magnitude and 11 milliseconds in time duration, actually imparted a 15g stress on a component with a 10 cycle per second resonant frequency and a 150g stress on a 500 cycle per second resonating frequency component. In other words, a rigid part of the component was stressed way above what the engineers had originally thought it would be, and a relatively heavy, flexible component was stressed less than what the shock test was designed to give to the item.

Although there was not sufficient reason on this basis alone to cancel the test, it did reveal an unexpected characteristic of the test.

In summary, I would like to restate the three factors which must be known to properly design a container for a relatively fragile item. First, the service conditions experienced in handling; second, the characteristics of the cushioning or shock isolation system; and third, the fragility of the specific item.

It is of interest to note that the packaging engineer can sometimes vary the service conditions factor by specifying a particular handling method and vary the cushioning material through selection. However, he has no control over the fragility of a specific item.

The greatest weight and cube saving in container size, as illustrated in this talk, can now be made, on a design basis, through the procurement of additional fragility information.

MR. CURTIS: Thank you, Lieutenant. I know there will be questions.

MR. PARSONS (Skydyne): The operating range you're talking about — is that a temperature range?

LT KLINGENBERG: That actually was a design range for the bearing area. The item must be in contact with a specific area of the cushion to afford the most efficient protection to the item.

MR. PARSONS: One other question. Do I understand it is your intention to give this time acceleration curve to these various things?

LT KLINGENBERG: Time acceleration curve?

MR. PARSONS: Yes. Rather than specify that a container withstands a 36-inch drop without damage to the items inside. Now, we don't know what the natural frequencies of the internal elements are. Is it the intention, as I understand it, that you are going to get a measurement of fragility of items we have to package and let us know what they are?

LT KLINGENBERG: Not entirely. We can't very well get fragility information on things that haven't been designed and used previously. The project was set up several years

ago, but has been discontinued because of a lack of an adequate project engineer to take over and conduct the project. We are looking for one right now. We plan to attempt to put all the various Air Force equipment into certain fragility categories and use the rating for a specific category. However, if a new piece of equipment were designed, we would like to be able to specify a test to the various manufacturers to determine what the fragility of this new type item would be.

MR. PARSONS: That's done a lot in the missile field, and I was wondering whether you preferred — and, of course, that would help Mr. Lapidus' situation too, because you can then, naturally reduce container size if the designer has some better information. But when you give his 15g and he designs for 15 and actually it will probably take 30g, surely you cut it down.

LT KLINGENBERG: That's also been our experience. The various project engineers tend to over-estimate the fragility of their item.

MR. PARSONS: Generally they package the airframe equipment with the electronics equipment. A little more careful design and you could have fragile assemblies that would be put into separate containers. You could then save a great deal of space in your shipment.

LT KLINGENBERG: That's right.

MR. CURTIS: Are there any other questions?

MR. PUSEY (Corps of Engineering): Would you care to go into any further detail about this environmental testing equipment, design of the major equipment, and so on?

LT KLINGENBERG: I am not the engineer on that project, but I have worked with him. He is essentially attempting to use an impactograph, which some of you people might be familiar with. The instrument isn't necessarily a laboratory type piece of equipment, but its simplicity lends itself to the application.

However, the system is more complex than just that. The impactograph is suspended in a spring system inside of a container. Metal corner plates are attached to the containers, so that the effects of the cushioning of the box itself would have relatively little effect on the indication that could be read in the impactograph.

One other suggested suspension system would utilize a spherical cushion around the impactograph since impacts have to be accurately measured in all three planes. However, we feel that a spring would be a more reliable type of shock isolation system.

MR. WHARTON (Container Laboratories): You described a specification on cushioning as being divided into five basic classes, I believe.

LT KLINGENBERG: Types.

MR. WHARTON: Types, and cited certain cushioning materials. I note the absence of sponge rubber and foam rubber, for example. Will they just be fitted into the five that you have selected, where they may happen to fit?

LT KLINGENBERG: We have included in this specification density requirements. Any of the foamed materials that meet these density requirements would probably fit between our type 3 and type 4 material.

MR. WHARTON: The reason I asked the question, and why it interests me, is that it seems as though you have selected the types of cushion with particular cushions in mind, thus favoring those particular materials fitting right into the classes, and anything else just has to squeeze in one way or another.

LT KLINGENBERG: No, the specification essentially wasn't set up on that basis. It turned out that it worked out in that way. The requirements as they are set up are performance requirements. In other words, although you have to derive a stress strain curve, we don't especially care what the stress is at a certain deflection. We are only interested in how much energy that material can absorb and at what stress it absorbs that energy. The design table was set up in the back of the specification on that basis.

We made each type of a sufficiently broad range so that we didn't get too many types. It turned out that the performance characteristics of most kinds of our cushioning materials were such that they fell into those five types.

VOICE: You mentioned that WADC was doing some development work on foam displace cushioning. Is that still the polyurethane?

LT KLINGENBERG: No, this is something new. Unfortunately, detailed information right now is proprietory. The process utilizes a different kind of material completely. We hope a relatively inexpensive material. The material would be shipped in a container or drum and then would be foamed in place at the packaging line.

VOICE: That would be both resilient and rigid.

LT KLINGENBERG: Yes. It would depend upon which type of material that would be used. One material naturally wouldn't be interchangeable with the other. We have a large number of applications for rigid materials for mounting odd shaped items in containers.

VOICE: When do you think such information may be available?

LT KLINGENBERG: This project is just being initiated and will require some time.

VOICE: Is it in the materials lab?

LT KLINGENBERG: Yes, it is in the Materials Lab. The contract is set up on a twelve months' basis for the equipment and additional time for obtaining a satisfactory foaming material. That gives you some idea at least when we will get our initial results, especially with regard to the necessary equipment.

VOICE: That's being done by the laboratory itself?

LT KLINGENBERG: No, it is on an outside contract.

MR. CAWLEY (Signal Corps): I think you touched on this point a few minutes ago, Lieutenant. Where are you getting your g-factors from? Are you getting them from the contractor or from the design engineer, or is the contractor in most cases the design engineer?

LT KLINGENBERG: Essentially we're getting them from the contractor. It is his responsibility to package the item, and as I understand, with most contracts he has to pay for the packaging in his contract price. We leave it up to them as to what the fragility rating should be. If it looks as if they're way off on their rating from our experience, we will certainly try to intercede and get it changed if possible. But essentially, nearly all of our information as to the design requirements come from their own project engineers. They are the people that build the equipment.

MR. CAWLEY: From the contractor? Thank you.

VOICE: Just one question. What was the number of that specification that you mentioned?

LT KLINGENBERG: MIL-P-6200.

MR. WHARTON (Container Laboratories): I would like to follow up the question that was just asked concerning the determination of the fragility factors.

Can the military require the contractor to actually ascertain the fragility factor of his item in order to evolve his design, or must the government simply say, you must pack it in such a way that when subject to such and such a test the item will not be damaged? In other words, can you actually require, or do you intend to require, the manufacturer to ascertain the fragility factor as a basis for his design?

LT KLINGENBERG: Not until we can give him a means of determining that fragility factor. The factor might be computed directly from construction of the item, which would be a very simple case; however, most items are much more complex. We have no test procedure and we know of none that anyone has used extensively that has been successful to determine a fragility factor.

MR. WHARTON: But my question is not one of being technically able to, but legally would it be proper procedure to require the manufacturer to ascertain his g-factor in order to design a pack, or must you simply say give us a pack that will perform. Regardless of how you design it, give us a pack that will perform

LT KLINGENBERG: That's the way it's done now.

MR. WHARTON: The second way?

LT KLINGENBERG: Yes, the second way.

MR. WHARTON: Is there any intention to do it the first way? Or could you even if you wanted to do it the first way, would you be allowed to?

LT KLINGENBERG: Yes, I feel rather certain that we would be.

MR. WHARTON: Good.

LT KLINGENBERG: However, usually what happens when we require something like that, they say how can we. We wouldn't be able to give them a method at this time.

MR. CAWLEY (Signal Corps): Isn't that up to the design engineer? Can't he in most instances determine fragility?

MR. LAPIDUS (Navy): Not now.

MR. CAWLEY: We have a problem coming up. That's why I'm asking. On this same thing.

MR. LAPIDUS: The experience today, Gene, that we have had in this area, and we have also gone into it rather extensively at Bayonne, is that — You use the term "fragility factor," which I like, but it introduces a new bit of language as far as we're concerned, because heretofore we've always thought in terms of the g-factor.

LT KLINGENBERG: Essentially the same thing.

MR. LAPIDUS: Maybe we're talking about something a little different, I don't know. I got the inference from your talk and from what you said recently that it might be a little bit different, and now you seem to hedge somewhat when you say essentially the same. I prefer to use the term actually. I think we should get away from the g-factor concept.

But be that as it may, the difficulty in the past has been that the factors that have been derived for this purpose have not been reliable. Had packaging designs been based on many of these factors that were developed for this specific purpose in the past, the chances are, as far as the Navy is concerned at least, we'd probably need about twice as many warehouses as we have right now.

What seems to appeal to the design engineers in making their determination does not seem to be suitable for packaging purposes. We have actually had items that have been assigned g-values of 4, for example, and yet, as in the case of an aeronautical camera, as this thing was packaged, it measured 125g's and it was installed in an airplane and still took good pictures.

I think that the essence of this whole thing revolves around what Lieutenant Klingenberg has said, that is, a uniform method for determining fragility values for this purpose,

and although there have been many attempts in different directions, most of which have involved — they've been destructive tests — have involved destruction of the item, they have not been suitable generally speaking for this purpose.

I am a little worried, of course, about this whole approach in tying it in with packaging directly. If this is going to be a destructive type of a test, then I can't help express the wishful thinking here that it be linked to the production requirements or manufacturing requirements of the product rather than directly to how you package the item, because it certainly would boost the packaging costs for obtainment of a piece of equipment out of all proportion to what should be paid. You could actually be doing a type of research and development in this contract and you'd have to pay for it by the contractual process.

MR. CAWLEY: I shouldn't think so.

MR. LAPIDUS: It might be difficult.

MR. CAWLEY: I don't think so. In fact, I think you would cut down cushioning eventually.

MR. LAPIDUS: Ultimately you would, once you get beyond the hurdle of knowing the values. I am talking about the initial approach.

MR. CAWLEY: Somebody has to determine those. I don't think it's up to the packaging man to determine.

MR. LAPIDUS: Right. I'm making the same point.

MR. CAWLEY: It's got to be with the engineer somewhere.

MR. LAPIDUS: I'm making the same point. I don't like to see it become a part of the actual operating contractual reporting.

VOICE: Then you'd have to go back to the maximum g-value, because you have to give the packager something. You can't say to him, you package it so the equipment isn't damaged. You have to say, you package it so if you pack it it won't exceed 15, 30, whatever you want.

MR. LAPIDUS: I agree there's great hope in that direction, providing we can get a uniform test for determining this value. We just don't have one.

MR. WHARTON (Container Laboratories): The reason I raised this question is that we have just had an experience along this line, and there are problems in getting the manufacturer to ascertain this g-value. Think of the small manufacturer, for example.

We were asked to evaluate current electron tube packaging. We went to the electron tube makers, and they couldn't give us the g-factors of their tubes. So we ascertained the g-factors of these particular tubes being studied, and we found that they were packing tubes for 150g when they wouldn't take 30. We found that they were packing other tubes for 30 when they take 150. So we as package engineers believe that's the only way to design properly, and yet in trying to recommend a way in which the government can be assured of adequate design, we find it impossible to require all manufacturers to ascertain the g-factors of their items. As of 1955 it seems to be impractical.

VOICE: I wonder if we could get a reaction from one of the industrial representatives, what their reaction would be to go to the contractor (inaudible) a specific piece or item (inaudible).

MR. NUNN: (Lockheed) No reaction.

It would be impractical.

MR. WHARTON: I would like to hear a reaction from a small firm to the same question. What if you were required to determine the g-factor of your item? Lockheed conceivably could set themselves up to do it with their engineering staff. The electron tube makers conceivably could give that data along with all the other electron tube data they have to furnish about the tube anyway. But the poor little guy — what's he going to do?

MR. NOBEL: We had a little experience along these lines. As Lieutenant Klingenberg pointed out, one of the important characteristics in mapping out shipping cushioning shock is getting as much bearing surface as you can. Is that right?

LT KLINGENBERG: Depending upon the material.

MR. NOBEL: And by getting at the design engineer when he designs these major components, like these plug-in units for electronic units, at the time of design, they have a way of saving weight, so they go so far overboard in saving weight that they end up with something with many fragile projections.

They have saved a lot of weight, but they've also created a terrific packaging problem. Now if you can get the design man to come off his lofty peak and talk to the packaging man just for a little bit in the beginning, you can oftentimes end up with a relatively symmetrical object which will still do the job. In fact, there is quite a bit of that going on now. They have people they call packaging engineers who are actually packaging items in small spaces in symmetrical design.

LT KLINGENBERG: That is one objective of developing a rigid foam cushioning material. Actually it's more of a blocking material to protect these fragile components extending out from the side of a piece of equipment. That will be a major application of that type of material.

MR. NUNN (Lockheed): I think I understood the Lieutenant to say you were making a study to develop some fragility measurements for categories of material?

LT KLINGENBERG: That was the object of our previous project, which was stopped, I guess somewhere around three years ago.

MR. NUNN: Has that been abandoned?

LT KLINGENBERG: Oh, no. The project itself has been discontinued. However, we are only waiting for the proper personnel to conduct the project. That's one of our high priority projects.

MR. NUNN: Then would you expect an industry would use these measurements?

LT KLINGENBERG: They would be guides.

MR. NUNN: And thereby eliminate testing of every part to determine the fragility packing?

LT KLINGENBERG: That's right. Essentially, if the new equipment would fit into one of these categories, there would not be a requirement to test every one. This would be particularly true of electronic equipment, since most of their components are similar. They differ only in their circuiting.

MR. NUNN: That I would think would be a better answer to the question — Joe, I guess you fired the question — that the package designer wouldn't be involved in checking

nor would the engineer be involved in giving us his guesses, for he's giving us a very low g-factor when in fact the part should handle more.

LT KLINGENBERG: That would be very true of electronic components. However, in several of the other fields it wouldn't necessarily be as true. Especially with camera equipment. Nearly every one of our cameras that come out now have larger and larger lenses, and each one has a very definite problem as to fragility, because of the large structural weights. With any item that is essentially mechanical in nature you are going to have continuing fragility problems because of the location of components and the arrangement of their relative weights. So the most benefit would be probably in the electronic field rather than in the whole field.

MR. PARSONS (Skydyne): Hasn't the tendency been — well, in the missile field, the tendency has been to test each specific component that goes into the fabrication of the missile and try to find out what its destructive point is, because you can say a SNARK mounted missile is 15g and subject it to 15g, and five years from now you want to use it, you may have destroyed an element. When you rip a missile apart and replace one single element, it takes forever to find out which one to replace. So consequently, I think that the trend has been that by drop test as well as by MP vibrators or anything else, to discover or try to find out what the fragility level of each specific item that goes into the component is. I mean, that's written, I think, in all missile contracts. They have to do that. Once you know that, then you are in a position to package them. That's true. But if you don't know it, it's sort of silly to say, all right, we're going to drop it so far, so many feet, so many g, and tell the packager, you are responsible for the equipment. That's ridiculous. I think the tendency has been to try to find out — that is, in the larger missile programs — to find out what the fragility level is.

LT KLINGENBERG: The missile field is the most progressive, I think, that we've found, and I agree that, because each missile is so radically different from the other, you could never make a generalization that all missiles should be protected at 15g. That's true.

MR. PARSONS: There's just one point that is absolutely afield from this — We feel that in the specifications for various containers — Take the submerged type containers. There is a preproduction test called for, whereby you submerge so many containers. We feel that this should be

tightened up, and that if you want a submergent-proof container, every single container that is manufactured as a submergent-proof container should be submerged and tested. That's a matter of our company policy, because we feel that you can test five containers for submergence and you may get five that are good, and out of the next hundred you may get five that leak, and that means you lose five very delicate instruments. So we feel that if you ask for a submergent-proof container, every single container should be tested for submergence. And I think it should be included in all accepted contracts.

MR. NOBEL: This is a unique and desirable industry approach. (Inaudible)

MR. PARSONS: I will forego the cushioning. Once you get a cushion you know it. But leakage is one thing you can get just from a manufacturing standpoint.

MR. CURTIS: You're interested in this larger container we're using for a missile?

MR. PARSONS: No, any submergent type cases.

MR. CURTIS: Any at all.

MR. PARSONS: Any at all. Any submergent type cases. That if submergence is in the specification, we think it should be 100 per cent tested.

MR. CURTIS: Mr. Nunn furnishes us instruments and so on we have in that type container. I suspect any number of you do the same. I just wonder how you feel.

MR. NUNN: I feel I have already gone in over my head in this technical discussion here. I have not found a metal container -- and I don't know exactly the type of container he's referring to, but I have not found a metal container that will pass submergence tests unless we do a beef-up job on the container. I am talking about cans that we can buy direct from can manufacturers. If we test after this rough handling test. We will give you the instruments in another package. I am sure when you ask me for a method II, which I guess is what we're talking about, you want a good one. If I can reach a flexible barrier by percentage or 100 percent check, sampling 100 percent check, and get a good pack, I think you want that better than you do a can that I have never been able to pass unless I reweld.

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MR. CURTIS: Gentlemen, it is four o'clock. Now, I am here to stay as long as any of you want to talk. It is just up to you.

MR. WHARTON: We got a little bit away from weight and cube, the subject of the meeting, I believe. But I would like to ask what I think is the crux of the entire afternoon session, and that is, what can be done about expressing a relative emphasis on weight versus cube versus cost. Is there any generalization, or is there any criteria which might be developed to indicate whether cost is more important, and if so, by what percentage; or if weight is more important, or if cube is more important, and if so, by what relationship? Are you willing to pay 10 percent more in order to save 20 percent in cube? Or something of that sort. Could anything be done to develop criteria along those lines?

MR. CURTIS: Well, in the Air Force, I must say, we handle packages to so many destinations, and there are so many handlings, that I don't have the answer, that's for sure. I expect you knew that before, when you asked the question.

But I do feel this, that through some standardization — now I don't have in mind in standardization that when I have a cup and a watch and this pencil, that we can become so determined to get standardization that I must spell out the exact dimension for this pencil, for the container, nor for the cup. But I do believe this; there is an area where we can control this and give a little. In other words, I may have a package which I have lost 10 percent cube by not being so specific, but I can within a group of items I am sure, and so can all of our suppliers, control it so that we don't get this little item in a package of this size which I have to probe through all the material, such as I mentioned yesterday — I don't know whether you happened to be there or not — but in our attempt in the Air Force to control weight and cube, when we find out how heavy and how large this watch is, we determine then that there is a family weight and size it falls in, and we have allowed a 10 per cent tolerance in both fields in the family, so that if you have a carton of this size, the watch will go in it and you also have items somewhat smaller that will go in. If you are within 10 percent variation between weight and cube allowances, we are going to be happy. I am not going to make you cut the lip off this cup merely because the item was a quarter of an inch smaller.

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I know this is not an answer to it -- I mean as to where we make money. But we made this determination; we have been playing with this for a long time. This isn't new. We have certain commands, TAC and SAC, and people of that kind, who have equipment to move and must move it quickly, so they are continually, or did in the past, coming in and wanting weight and cube data on tables of equipment, for example. The way we come up with the 10 percent is that we can stand 10 percent, because in going through a large table of items, some will be a little less and some a little more, but if it's in the 10 percent, maybe we will average out at only 5 percent loss of cube and weight. That's all we predicated our study on, that allowable 10 percent error.

I am sure I am speaking for Colonel Mason as well as myself when I say that we are not going to do a thing that is going to impose any hardship on any of our suppliers. What we want is to get some realistic pack here that will give us the protection we want. We will have some control over the size of the package and the weight of it, not only by control over what we save in packaging materials but what we save in our warehousing operations and in our transportation operation.

Also among the things in this manual we have developed is that we are not going to tell Lockheed, North American, or you, or anyone else, except in some few instances when our packaging man is convinced there is only one way to package the item, that you are going to always have to put it into a tin can, or spirally wound, fiberboard, or what-have-you, by submethod. If we know that a 1-A preservation pack is what is needed for this item, we are saying to you in our manual that 1-A is it -- we are firm on that -- and that we have two or three methods we prefer, but that is only merely to let you know that we would like to have it in whatever the container might be submethod. But if you are set up to give us the same method of preservation protection, the basic, which will meet all the tests that are necessary to assure it's being complied with, how you get it done is entirely up to each one of our suppliers.

MR. WHARTON: I was thinking more of the individual containers where I noticed, for instance, a tendency to accept -- let's say cylindrical heavy steel containers or boiler-type containers, because it's deeper, where of a different material and perhaps a rectangular design, the savings in weight and cube could be cut in half, but the cost would go up maybe 50 percent. I know there are no rules of thumb, but I simply

toss out the question and perhaps the challenge — Could not criteria be developed to furnish guidance as to how much more you could pay for the container if that extra cost of the container resulted in a certain amount of savings in weight and cube?

MR. CURTIS: I am convinced we have people who have solved problems similar to that, and probably a study could be made and we could come to the conclusion, and maybe we should — I am not saying we shouldn't — but we believe this in our office; we will sacrifice money one place or the other sometimes, but we are vitally interested, from a logistical plan if nothing else, in controling size and weight. If we have to spend a few cents more for it, I expect we will have to pay it, but that is our program now. Maybe you brought something up we should look into, but I hardly know at the moment — it is a pretty good problem — whether we should disregard or attempt to standardize by family size and groups, or sacrifice that for a possible savings in a container cost. So I don't have the answer, but I will take it back and see what our analysts can do, back in the shop. I am not a very good analyst. We will toss it at them and see what the reaction is.

MR. WHARTON: The encouraging part of this whole picture, Mr. Curtis, is that in most cases when you save weight and cube you get the additional savings of cost of the container materials and the resulting indirect savings on down the line.

MR. CURTIS: That is it. It would be pretty hard for me to say how much we would save by sacrificing price on containers. If we are bringing it into one of the AMA's for an overhaul job, we have no such problem, but subsequent handlings to faraway places become an important factor.

Gentlemen, if we have exhausted the questions, the recommendations and so on, I want to express to you my appreciation for your coming in and keeping this alive. I am sure I couldn't have done it, because you have had so much experience in the field, especially on the other end. It has been a real pleasure to be here. It has been nice to be with you, and I especially want to thank Mr. Sherk from Allison Division and Lieutenant Klingenberg from the Laboratory for helping me. Mr. Lapidus had to leave to catch a bus. Every one of you who contributed, I appreciate a lot. Let's stand adjourned.

(Whereupon, the conference adjourned at 1610 hours.)

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Afternoon Panel Session

Wednesday, October 12, 1955

B4. Introducing New Materials and Processes to Government Agencies

Chairman, Mr. L. C. Heller
Head, Packaging Section
Office of Naval Material

Advice on ways of introducing new developments to government agencies.

Mr. D. A. Holenshade
Office, Director of Transportation
Air Force

Mr. J. D. Studley
Office, Deputy Chief of Staff, Logistics
Army

Panel Session B-4 Wednesday PM Oct. 12, 1955

Introducing New Materials and Processes to Government Agencies

Mr. L. C. Heller
Head of Packaging Section, Office of Naval Material

In planning the program for this symposium, it was thought there would be a number of people here who would have questions on how to go about bringing new developments to the attention of the various Services. I know it has been quite a struggle to some people coming here in the past ten years. I have run into any number of people who spent three or four days around Washington trying to find the right people to talk to. They don't get an intentional run around, but in some cases it would appear that way.

A good example of that happened a couple of years ago. I was with Army Ordnance over in the Pentagon at that time. One morning, about a quarter of eight, two fellows stopped at my desk and asked me how to locate a particular lieutenant colonel. I dug it out of the directory, and gave them the information, and four hours later the Aide to the General in charge of our Division came down the hall with these two fellows in tow. It so happened I was the one that had the answer, but it took them four hours and visits to a number of offices to find me. Those things do happen.

We have one office in each of the Services that has a very definite interest in each one of the materials that we use in packaging and in materials handling equipment. Recently the Department of Defense established a standardization program and made definite assignments within the Departments on standardization. One Service in a Department is assigned the responsibility of preparing specifications or standards and in each of the other Departments a Bureau or Service is designated as having a major interest. The preparing activity, or preparing service hasthe responsibility for preparing the specification or standard,coordinating it with the interested offices throughout the services.

We felt that about the best thing we could do this afternoon would be to throw the meeting open to questions, and attempt to answer them. Prior to that, I'd like to give you a little idea of how the standardization assignments rest on some of the materials. For example, the preparing activity for interior packaging bags is the Ordnance Corps, Department of the Army, and the Bureau of Aeronautics and the Air Force are listed as having a major interest. Responsibility for paper shipping sacks and slack barrels are assigned to the Quartermaster Corps of the Army with the Bureau of Supplies

and Accounts of the Navy and the Air Force listed as interested offices. Reusable metal exterior shipping containers are assigned to the Air Force with theQuartermaster Corps and the Bureau of Aeronautics being interested offices. Nailed wood boxes are a Quartermaster responsibility and wire bound boxes a responsibility of the Bureau of Supplies and Accounts.

Prior to this meeting Mr. Studley and Mr. Holenshade and myself got together to discuss it a little and I'd like to ask Dan whether he has anything to say before we throw it open to questions.

Mr. Holenshade: Nothing specific, Les, at the moment. I would like to mention that the office with which I am connected in the Headquarters, the Packaging and Materials Handling Division, is under the Director of Transportation, and our office is immediately concerned with policy at that level. We buy nothing, but we will do our best to steer anyone coming to see us to the right place. With a little knowledge of the Air Force organization, the place to go isn't too bad.

I have, to assist me, on my left Mr. Olevitch, who is Chief of the Packaging Section of the Materials Laboratory at the Wright Air Development Center. In the Air Force, the Air Material Command has the responsibility for procurement, supply, and distribution. The Air Research and Development Command under which the Wright Air Development Center comes, has the responsibility for testing new materials, research and development and writing specifications.

I have told you this very briefly. This will give you a little stock to take on from there later.

Mr. Heller: Jim?

Mr. Studley: I don't know that I have much to say at this time. I have one little thought. In spite of standardization assignments I understand there will be some sub-assignments. For example the Quartermaster Corps may have an assignment which would be sub-assigned completely or in part to the Air Force. We do not intend to scrap know-how in a particular field that may have been developed in the past by the Ordnance Corps, or by the Bureau of Aeronautics, or what have you. However, your first guidspost will be the technical service to which the broad area is assigned.

Mr. Heller: In my particular office, we are in about the same position as Mr. Holenshade. We are concerned with policy for the Navy Department. However, we do our best to steer anybody to the proper bureau within the Navy when they come in with a problem on specifications, standards or a new development.

I'd like to open the session up for questions. I would also like to have anyone raising a question to identify himself for the benefit of the reporter.

Mr. E. F. Galivan, Wire Bound Box Association, Chicago: Will there be a list of the custodians of different specifications available to help the supplier? I know what mine is, but I might want somebody elses.

Mr. Heller: The particular list I have here is not available for distribution.

Mr. Galivan: Will it eventually be available?

Mr. Heller: I think eventually it will be, yes. This whole Standardization Program as it is going into effect now, is comparatively new and actually has not been completely finalized.

Mr. Charles Ferguson, Textile Bag Manufacturers, Assn.: You mentioned that QM has the responsibility for the specifications on paper bags. Can you tell me, sir, who has the responsibility for unlined textile and the laminated bags?

Mr. Heller: QM also has the responsibility for the textile and laminated bags.

Mr. Ferguson: Would that be QM in Philadelphia?

Mr. Heller: Could you answer that one, Jim?

Mr. Studley: I think it would be Natick.

Mr. Hoffman, Dupont: Could you tell me something about the function of the various Packaging Boards, the Navy Packaging Board; also the Army Packaging Board?

Mr. Heller: Jim, would you like to give a run down on the Army?

Mr. Studley: It might help. In the Army the Packaging Office with which I am connected is a staff office. We are under the Deputy Chief of Staff for Logistics. The Deputy

Chief of Staff being one notch higher than the Assistant Chiefs of Staff. We handle all matters, as has been explained by Les and Dan at a policy level. The Army Packaging Board is primarily an advisory group for reference purposes of our office.

The Army group is made up of a member and an alternate member from each of the 7 technical services. In other words, we have this Board on which we lean for advice when as and if some problem comes up on which we need advice of that type right across the Army. There are many other angles but I believe that is the one that you are after--is it or isn't it, Mr. Hoffman?

Mr. Hoffman: Yes, that is right.

Mr. Studley: Of course, we also use the Board to disseminate policy thinking that is in the making, or newly made. We use the Board as a media for working back to the technical services in many ways to get quicker action, so that there is intimate contact between our thinking at the policy level and the overall Army policy level, and the thinking back in the technical services.

There are two major functions of the Board--there are a lot of others. If you are really interested, we could provide you with the regulation that covers it all, but I believe those are what you are after, are they?

Mr. Hoffman: Yes, sir; thank you.

Mr. Heller: The Navy Board is set up in a similar manner, established as an advisory group to the Chief of Naval Materiel. It is composed of representatives of each of the Bureaus, and the Marine Corps. One thing we do in the course of our Board meetings--we meet regularly once a month--is to bring up new materials or new processes, or new developments which come to our attention when we feel that there is general interest within the Department.

We also set up task committees to work out specific problems as they arise and use the Board as a means of disseminating information of general interest. If there is a particularly interesting development, we at times invite people to come in and give a presentation to the Board on it.

Does that pretty well answer the question?

Mr. Hoffman: Yes.

Mr. Holenshade: The Air Force, at present, has no Packaging Board. When the Packaging and Materials Handling Division was established shortly after the Air Force Packaging Board was dissolved the functions of that Board were taken over by the Division within Headquarters. I can say that there is very close cooperation between our office, Mr. Heller's office, Mr. Studley's office. I am invited to all Board meetings. I get copies of all their minutes, and we disseminate that to the Air Force.

Mr. Linderoth, Arvey Corporation: Maybe your last comments partially answered my question, Les, but I am wondering for example about a product which could be widely used, say, for interior packaging, by all the services or by military contractors, and which is more or less newly available. It is not an item which has been available for that type of issue on a large scale, and for which there was probably no specification. What would be the quickest method of acquainting various military offices concerned with specific packaging or with advising contractors who might be asking them questions about their problems and about the fact that this material is available for general use without actually having a specification?

Mr. Heller: Of course, the one thing that would have to be done is develop a specification around the material before it could be put into widespread use, or referenced in the specifications. If the material met an existing specification, fine; if not, and there was sufficient interest in the material, we would set the wheels in motion to develop a specification.

Mr. Linderoth: What I have in mind is a paper packaging material which could be used in military packaging under the general requirements of MIL-P-116 or JAN-P-100 as a blocking or cushioning material, and so forth. There is no specification out on it, but it could be used by a manufacturer without a specific specification under those particular terms as a paper dunnage. I am wondering what the method would be of making it known that the type of material is available.

Mr. Olevitch: Well, if you didn't know what to do, then, for the Air Force, come see me and I will tell you what to do. You should come to the technical services of the Army or Navy that might be concerned. They might answer that a little later; however, if this particular product you might be

talking about might be a space filler, it's not, let's say, too critical a thing from the standpoint of writing a specification. It is the intent of MIL-P-116, and other general performance specifications to relieve you from the load of evaluating or testing each and every doggone thing that comes along. I would suspect that if you can economically convince some company that has a contract that he could use the material you are talking about under MIL-P-116, or any of the general specifications, which are performance types, there is nothing to keep you from selling it.

Mr. Linderoth: I know that an individual contractor could probably use the stuff. He'd get a deviation or probably some type of permission from the contracting office.

Mr. Olevitch: We had a situation with a solid textile material which actually, under MIL-P-116 or contract reference MIL-P-116, could be used--no questions asked. However, the people that are making it felt that it was good to be covered by specifications, and some of our Air Force installation felt also that it was desirable to be covered by specifications. The problem waspresented to us and we have a specification in circulation for coordination now, but I would hasten to add that you won't want to cover every material that American industry can produce by specifications. That is why we resorted, in many cases, to performance specifications.

Mr. Linderoth: Well, by the process of working with individual contractors, as you say, and by the process of advertising and publicity, and just getting around the market with a new product, people will eventually come to know about it.

Now, I was wondering if there was any sort of shortcut, assuming that it would be of sufficient interest to people in military packaging positions, to merely let them know in some swift manner, throughout the services, that this type of stuff is available.

Mr. Olevitch: In the Air Force, you could send in a material to us and you could send in also a letter saying that this material was available, and being sold to various Air Force, Air Materiel areas.

Mr. Linderoth: In other words, it would just be a matter of writing to--

Mr. Olevitch: That would be more like letting an advertising man know what it is.

Mr. Linderoth: Would that apply to your office in the Navy, Les?

Mr. Heller: Yes; we would not necessarily promote any product like that. Also, as Al said, it is impossible to cover all the materials that are used by specifications. As he pointed out, we have the performance type specifications, and as long as the performance requirements are met, any of the materials can be used. That is particularly true of the type of material you are talking about. It is a matter of your selling it to the user.

Mr. Studley: I was going to add that by contacting the different services you had in mind, you'd only be doing it for their informational purposes; because of cost, they'd never spell out in the contract Item X as a requirement when it is a proprietary item. You would only get in under a performance type of contract.

Mr. Linderoth: I think there are a lot of products that fall in that category. In other words, people would like as many offices in the military to know about it as quickly as possible without just having to wait for all the wheels of advertising and gradual contact to do the job. I was wondering what the procedure would be.

Mr. Heller: Actually, it would be very difficult to do.

Mr. Studley: It would be difficult, particularly because the contracting officers are so widespread.

Mr. Heller: Any further questions?

Mr. R. J. Piltz, Kimberly-Clark Corporation: I don't know if you can answer this one, as it doesn't have to do with packaging. We have developed a disposable item that we believe would be of interest to the medical branch of all the Armed Services. Now the question is, where do we start, who do we present the item to? It's something brand new. We wanted to save some of this running around that you mentioned at the start and definitely start at the starting point, if we could.

Mr. Studley: You're extremely lucky, Russ, because there's only one place that that is handled for the Armed Services, and that is in New York City. Eighty-four Sands Street, Brooklyn, New York.

Mr. Olevitch: If you want to write to the Air Force, as was said, New York would be the best place. But the Air Force activity concerned with medical is the Aero Medical Laboratory at Wright Field. But this place is probably the most centralized place in the whole Department of Defense for that.

Mr. Heller: We have representatives of all the services right there, so that particular one is a simple one.

Mr. Olevitch: In the absence of questions for the moment, I might say something for your guidance based on my experience with people coming in with products to me, and I'm sure it's true of all other services. I would say the greatest failing that contractors or people having new products to sell is that many times they come in with a product and all they know is that they have a product. I won't say that it's widely prevalent but it is a failing particularly in the case of salesmen. In other words, they don't know what their product will do. They do not know their product and it's actually a waste of time, or certainly it will slow down your selling that product if you don't do some of your own digging before bringing it into an agency.

Unless the product really is unique, we don't want to spend a lot of our time finding out what your product will do for you. We don't want to be in a position of doing your research. This isn't the general thing. Most people know their product or they'd be fired. But I would say this is a rather frequent occurrence. You can hasten it greatly if you will know the properties and know pretty well where you think it will fit in. It would be well if you engaged the services of some laboratory and spend a little money and prove out your ideas or your applications.

Mr. Heller: To add just a little bit to that, Al, it hasn't come up recently, but it hascome up in the past where a supplier comes in with a new development in material which he would like to offer under an existing specification but has no data to show that it meets the specification requirements. When he comes in he'd better come in with the complete laboratory results on that material because we are not in the business of testing material out for a contractor to find out what it will do. He's got to show us what it will do and then if it fits into our scheme, fine.

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Mr. J. D. Miley, Continental Can Company: Along that line, if you have something that your product could fit into as an end use, how do you go about that? In other words, do you have any list of agencies, what the scope of responsibility for those agencies are, where the agency is located and who to contact in that agency? If you had something more detailed than what you read off at the beginning of the conference, that would help. Is there such a thing?

Mr. Olevitch: In the Air Force, me. Wright Air Development Center. I'll let Navy tell you about them.

Mr. Heller: We would lead you to the right place if you come to our office. It depends on the type of material as to where the major interest in the Navy lies.

Mr. Miley: Suppose it's something very common, such as household goods, I presume you'd go to the Quartermaster. That encompasses a great deal of territory. Where do you start?

Mr. Heller: There you're going to have to get the particular office within the Quartermaster responsible for the item.

Mr. Miley: I understand field agencies can requisition up to $1000 or something like that. Central agencies up to so and so, just for that item. There are so many end uses. Is there anything in writing, any list of a sort like that that shows you where you'd have to go in order to get this authority?

Mr. Heller: You'd just have to go to the technical agency.

Mr. Miley: Start off and trickle down the line?

Mr. Heller: Yes. We have a number of publications which are available. One of them is "How to Sell to the Department of Defense." One is "Dealing With Navy Prime Contractors" and one is on "Purchased Items and Purchasing Locations for the Department of Defense." These publications are available to you.

Mr. Miley: Those would be something of what I was thinking of.

Mr. Heller: There is someone on the Small Business Desk down in the lobby and they could arrange for you to get these or you could pick them up yourselves.

Mr. Olevitch: You can get them from the Superintendent of Documents.

Mr. Linderoth: I think you can pick them up off the desks in most offices.

Mr. Wahl, United Can: This is directed specifically at the Navy. On our fiber cans we've gone through development both you gentlemen mentioned. We now have a specification ready to come out that will clarify the situation quite a bit. What's our next step? Do we go to GSSO? It might have been covered before I arrived. I apologize for coming late. As far as the Navy goes, what do we do next?

Mr. Heller: Well, it would probably be set up as a stock item as GSSO, if there is sufficient volume required and a continuing need.

Mr. Wahl: We anticipate a large usage item. We think the next step logically would be to have a stock number.

Mr. Heller: In your particular case, I think you are to start out with theBureau of Supplies and Accounts.

Mr. Wahl: They're in charge of the specification anyway.

Mr. Heller: GSSO comes under the Bureau of Supplies and Accounts.

Mr. Wahl: Does that take place automatically, or would it be to our advantage to do that.

Mr. Heller: It would be to your advantage to contact the people in S&A. If they're sufficiently interested, they could take the action to see it's a stock item.

Mr. Wahl: How about the Air Force, would it be through you?

Mr. Olevitch: If there are depots that have to procure it and the specification is published, and some of the depots will procure some such containers--as soon as the specification is published there will be a requirement for the containers and automatically they have to stock a number of it. You wouldn't have to do much pushing then.

Mr. Wahl: That will take care of itself?

Mr. Olevitch: Yes.

Mr. Studley: All your thinking there is to get the cans into use by the depots, Army, Navy and Air Force. Aren't you giving thought to selling them to contractors?

Mr. Wahl: Definitely. But we were wondering specifically if we should go to GSSO.

Mr. Studley: 39505 is in existence.

Mr. Wahl: That answers my question; thank you very much.

Mr. J. Mc Nulty, GSSO: As far as this goes, in your particular case, I don't think you want to sell us on the idea of cataloging, because actually it originates in the Bureau of Supplies and Accounts, but first there must be a demand in the field. If we carry it in our catalogue, anyone could buy it.

Mr. Wahl: We didn't know whether it wasa case of the cart being before the horse or the horse before the cart, whether we have to create the demands before it goes in the system.

Mr. Mc Nulty: That's right. Somebody has to want to buy it.

Mr. Olevitch: Field activities have to create the demands or if they are unaware of it, and find it's economical, the demand will be created.

Mr. Mc Nulty: This fiberboard cannister, if they find it can be used for say electronics, they would write it into the electronics specification, and it's part of industry. People find out there is such a can. They will then go after it.

Mr. Linderoth: As I recall in Navy Depot operations, isn't there some kind of stipulation in the manual that when a depot is buying consistently above a certain monetary level then it becomes mandatory that GSSO stock it?

Mr. Mc Nulty: That's true.

Mr. Linderoth: There is a certain monetary level according to the level they have to have and they initiate a request.

Mr. Mc Nulty: The Bureau of Supplies and Accounts assigns it through our contract. Or if it's a BuShips item, BuShips, or the technical agency controls it. The only thing we do is keep it in the catalogue and we buy and distribute.

Mr. F. Scalise, Olmsted Air Force Base: Go down to the next lower level now, to the place where they actually generate requirements for such a product that Mr. Wahl has. That would be done by us stipulating in our contracts that the contractor use a container of that specification. However, we would find in our depot operation we may have use for that. So our natural step would be to requisition it through our prime depot. By doing so they would have to automatically stock this and asthe requests came in and the demand was generated, which we determined on the stock level, of course that would be what they would buy.

Mr. Heller: Initially, it would possibly start out by authorizing local procurement, and then if you have use developed, it would automatically be set up as a stock item.

Mr. Linderoth: I'm wondering if the group might not like to have the specific official addresses of you four gentlemen so that at some future time if they had a specific question they would know exactly where to send it to your office.

Mr. Heller: As far as I'm concerned, it's the Office of Naval Material, Code M721, Washington 25, D. C. I would automatically get that in our office. If it's a question we had the answer to we would answer it. If not, we would put it into the proper office in the Navy for reply.

Mr. Olevitch: For Air Force, it would be Commander, Wright Air Development Center, Attention WCRTH-5.

Mr. Holenshade: Head, Packing and Materials Handling Division, Headquarters, USAF, Pentagon Building, Washington.

Gentlemen, at this time I would like to mention the fact —I've already told you—we're at the policy level. Mr. Olevitch is right in Research and Development. We have a packaging and materials handling division at the Air Materiel Command who are very much interested in the operational aspects of packaging. They actually do it within the depots, and Mr. Scalise here is at one of those depots. Those people like to know of new things.

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Mr. Studley: Within the Army, having once gained a concept of what your interest might be, I would probably refer that to one or more of the technical services. and I have a list in the office of the Members of the Packaging Board, who in most cases--I guess in all cases--are the same persons who are in charge of packaging for the particular technical service and they're themen you can best do business with face to face, so to speak.

In case some of you would like a copy of that, we can provide you with a copy of the names and addresses of the Board Members, not asBoard Members, but you'd be contacting them as the particular technical people within the particular technical services. Had I known that question was going to arise, I would have brought over a few sheets. Would that be helpful?

My address is, Deputy Chief of Staff for Logistics, Room 1C564, Pentagon. You can hang some more on there if you want, Chief of Staff for Standard Logistics Branch. Maybe you'd better put that on.

Mr. Heller: Do we have any further questions?

As I said when we opened up here, the primary purpose of setting this particular session up was to give the people an opportunity to shoot some questions at us. But apparently there aren't too many questions.

Mr. G. M. Hoffman, Du Pont: In the case of a special QPL list, can a contractor use a material which he thinks will meet that specification but which is not on that QPL list?

Mr. Heller: No.

Mr. Hoffman: I see; that's the prime purpose of it.

Mr. Heller: Yes.

Mr. Studley: Is that all, gentlemen?

(Adjourned 1450)

Afternoon Panel Session

Wednesday, October 12, 1955

Panel Session B-5 Wednesday PM Oct. 12, 1955

Automation in Handling

Mr. S. S. Nicholson
American Can Company

I'm going to start out by just briefly introducing each member of the panel. Later you'll have an opportunity to hear each member express himself at a little more length, but we'll start to introduce Mr. Glen Johnson, Director of the Material Handling Development Center, Clark Equipment Company; Mr. William G. Nichol, Assistant to the Vice President of Operations, U. S. Steel; Mr. A. K. Strong, Materials Handling Specialist, American Cynamid Company; Mr. O. B. Carliss, Director of Engineering, Yale & Towne Manufacturing Company; Mr. J. E. Cave, Supervisor of Research & Development Section, Materials Handling Engineering Staff, Ford Motor Company, Detroit; Mr. L. J. Bardsley, Assistant to Vice President of Manufacturing, Johnson & Johnson Company, New Brunswick; Mr. Irving M. Footlik, President of the Footlik Associates, materials handling and consulting engineers, Chicago. Mr. Footlik may be known to some of the folks here as a faculty member of Northwestern, also Illinois Tech. He is Secretary of the College Industry Committee on Education, and he has numerous other commitments in industry; and so with that, I'm going to sit down.

The subject for today's discussion is "Automation in Handling, Covering Recent Developments in the Use of Automatic Warehousing and Production Handling Equipment."

One of the prerogatives of a chairman of a panel -- in fact, he has two prerogatives; (1) he doesn't have to do any work, because the panel does it all, and the other -- that he does have the right to make comment. I'm going to make my one comment now.

I feel that the use of the word "automation," particularly as it applies to materials handling, is in a somewhat confused state. "Automation," particularly in warehousing materials handling, I don't think should be used as a catch term or a catch phrase. There has been a tendency to throw everything under the word "automation," and I think it's setting up certain roadblocks in accomplishing some of the things that industry would like to do in that direction.

In considering application involving warehousing and processing, it is generally found that it is necessary to link together a number of methods of handling. Now, that's

particularly true in the can manufacturing industry where every year we handle billions of individual objects, some of which run as high as a ton or two tons in weight, some of which go down as low as a fraction of an ounce. We handle all kinds of shapes, sizes, from large drums all the way down to small can parts.

In handling this material, we found that it is necessary to use almost every known form of materials handling equipment and method.

In the general handling of canned materials, we always think of the incoming material such as tinplate being received and handled by fork truck, transferred by elevator or lowerator to a point of rest, put into production where we go into our nearest approach to automation.

Once a sheet of plate goes into the can manufacturer, from then on, until the finished product comes out of the line, we have our closest approach to full automation. That's been true in the can industry for many, many years, and people who have been in the can business a long time don't look on that as anything new or remarkable because automation has existed for the can manufacturer for 30 years.

We carry the parts, the cans, and process them over cable conveyors -- over magnetic conveyors. In some cases we blow it along with air, until finally out of the back end of the line, we get our finished can.

Once we have the finished can, we run into materials handling problems, cans or packages are handled in all sorts of ways. We pack in bulk to put in large paper bags and cartons and boxes loaded directly into trucks, loaded on pallets; and as far as handling goes, we employ somewhere along the line of the finished product handling almost every known method.

We handle a large percentage of our cans using fork trucks. Now, with fork trucks and pallets, we employ rams, scoops, side shifters, magnetic clamps. Everything that's on a fork truck today, with very few exceptions, you'll find in use somewhere in the can industry.

In an attempt to approach automation in warehousing, the can industry uses radio-controlled fork trucks. That's

proven to be a tremendous tool in speeding up and expediting the movement of packaged material, particularly in large warehouses.

There's a little sidelight on that. I often noticed where you go into a warehouse where you have radio-control fork trucks that you can never surprise a fork truck operator, because the minute a supervisor walks in the building, every fork truck operator knows who's there and which way he's headed.

In warehousing operations, where we tie in automatic pallet loaders and unloaders, conveyors serve as one of the major means of handling palletized materials. One of the tools which we feel must be most generously used in attempting to promote most efficient warehouse flow is the systematic study of operations, facilities and equipment. In making in-plant studies, our particular company's recommendation is that we use flow and process chart methods to study improvements or new developments in materials handling equipment, methods of packaging which would include specially engineered containers. Changes in shipping methods can obsolete facilities and equipment which have been doing a good job for you; and unless constant alertness is maintained, we can find ourselves at a tremendous competitive disadvantage.

I would like to emphasize that careful followup of efficiency of equipment and flow of material is a must in today's rapidly changing materials handling situation if the company is to stay abreast of the changes and development which can affect the company's actual life.

While touching on warehousing, I'd like to point up the need for close cooperation in the planning of warehouse facilities to be sure that the latest materials handling methods and equipment are employed.

In today's warehousing, there is very far-reaching thinking going on, and I think one of our panel members will bring this out a little later. Today when we plan in a warehouse, we can't plan for today or next year. Any warehouse that's not planned for 10 years is obsolete the day that the final brick is put in place.

Unfortunately, in too many cases -- I except all companies present because I'm sure it doesn't apply -- materials

handling is considered only after the building is completed or someone signed the lease and a materials handling engineer goes in and tried to make the best of it. That's a sure way to have a high operating cost.

In certain industries, including the can manufacturing industry, there is a continuing growth of package development that enables the manufacturer to pack the product in the package or unit that will continue as the holding package all the way through the processing -- in our case it would be someone filling the cans -- and final delivery to the point of use in the one package. The economies in this method of packaging material can extend far beyond the can manufacturing industry. It's something that's growing in American industry today, and I believe that it's something that we're going to continue to see grow. It's unitized packaging and unitized handling that will receive greater attention.

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New Developments in Horizontal Handling

Mr. Glen R. Johnson, Director
Material Handling Development Center
Clark Equipment Company

I don't know if many of you are acquainted with a new development known as the Clark Mobile Van System. It's a method of transportation and materials handling. The system has been under development for approximately 2½ years. The system entails the use of large containers. If only in this particular instance, the containers are like the body on a highway trailer truck, the dimensions being eight feet wide, eight feet high. One length will be 17'6". There is a plan for other lengths of 22 feet and 25 feet. These large containers or vans have automatic locking devices. They are either picked up with a large fork lift truck or a straddle carrier. The vans can be loaded on the flat bed of a highway truck, automatically locked in place. Three of the 17'6" vans can be placed on an ordinary flat car which has been modified only by the addition of mobile locked planks, the planks consisting of 10- or 12-inch wide channels which are inserted in the flat bed of the car in place of some of the affected boards.

Now, what does this system provide? Above all, it gives you flexibility of transportation. Visualize the vans being loaded at a manufacturing point, placed on a highway truck, hauled to a marshalling yard center, taken off the truck, placed on flat cars, hauled to the next city. The freight inside can be unitized and unloaded immediately, or the vans can be stored for unloading at a later date.

Now, in our company operations alone, we have six plants, all located in Michigan, a distance of approximately 130 miles. We are planning to use 140 of these vans in our own operation. Instead of storing merchandise in a building as the merchandise comes from vendor plants, it will be left in the vans. The vans will be stored in the yard.

When the material is needed on the assembly line, the vans will be picked up, placed on a flat-bed trailer, and hauled by a small tractor right in the assembly line, and the material will be unloaded and used immediately in the manufacture of our products.

I believe next week the full-fledged system -- I should say on a test basis -- begins on a run between Chicago and East Coast cities of Philadelphia and New York on the Pennsylvania Railroad, starting the first run with approximately 50 vans. The Fruehauf Trailer Co. has been licensed by our concern to manufacture and distribute a mobile van system.

I'm not going to dwell at any further length on the subject. I want to bring you the idea to tell you that there are movies available, brochures available, fully describing this system. The reason why I bring it here is because, as the Executive Vice President of the Fruehauf Trailers stated just three weeks ago, he could see such an impact on American economy, transportation, that within five years he visualizes his firm manufacturing nothing but mobile vans and will discontinue the manufacture of highway trailers as they are manufactured today.

Another materials handling device which has been with us a long time but has seen little use outside of the lumber industry is known as straddle carriers. You might call them lumber buggies. The vehicle straddles its load, picks it up, carries it, deposits it. It's a one-man operation. It loads and unloads itself. These carriers though are moving into markets and uses previously not visualized. The reason why they have a high road speed of 50 to 55 miles an hour in operation is that the range of operation is not limited to one or two miles, but some operations are hauling materials as much as 50 miles. The turn-around time is almost instantaneous. Nobody is waiting to unload the carrying vehicle.

In our fair city of Battle Creek, Michigan, we have a scrap dealer who for the past four years now has disposed of his fleet of dump trucks and uses nothing but straddle carriers, providing boxes which he deposits at various manufacturing plants, loads them with scraps. The scrap dealer picks up the boxes and transports them downtown, and our building supply dealers deliver lumber, bricks, blocks, cement, from their supply yards to construction job sites.

In a test in Minneapolis last summer, a lumber yard was not convinced until they saw it with their own eyes that a straddle carrier taking the same size of a load as could be hauled on a flat-bed lumber truck delivered it to a job site of 15 miles distance and the straddle carrier was back to the lumber yard half an hour before the truck got back. They didn't believe it, so they had to go through it once more, and the straddle carrier this time beat the truck by 45 minutes.

With this proof, this building supply dealer procured two straddle carriers to do nothing but provide this highway transportation. In the steel plants, they're hauling ingots between heats in the steel mill. They're also hauling finished rod, bar, angle stock, from the end of the rolls to storage places, which may be a mile or two miles' distance from the plant, it's becoming increasingly important to the steel industry to use this mode of transportation because it's flexible, it's fast, it's efficient, and it's a one-man operation.

Somewhat allied to the steel mills are some of your bridge manufacturers who are using these straddle carriers to haul long bridge sections from the fabricating plant to the construction job site, so don't be surprised one of these days if you encounter a straddle carrier going down the highway with a long five-foot section of bridge in the belly, because it's being performed; and one of the payoffs happened to be in one of the oil refineries when they were using a straddle carrier for a maintenance job, and yet they wanted to move a large, dangling tower a distance of a half a mile. This tower happened to be, roughly, 100 feet long. They had half of the engineering department out there trying to figure out how to move this large, dangling tower for the distance. Along comes this one man on the straddle carrier asking what he wants to do. He explained the job and said, "Stop the job." He straddles it, picks it up, and hauls it a half a mile. 15 minutes later he places it down and says, "There you are" -- one man.

Now, in this oil refinery they use a straddle carrier for moving machinery, production tools, just because of that one man who had the insight and knew what that truck would do.

So much on straddle carriers, but I can visualize today that these vehicles will be used as vehicles of war -- and I hope we never have another war -- but let me say that the idea has been proposed to have a type which would float on water -- one which would unload LT boats, one which would be a tank retriever.

There are all kinds of manners and means in which the straddle carrier can be used. All you have to do is get a thought started, think about it, and you'd be surprised at

the number of applications of this tool which has really not yet started to be used.

Other developments coming along which have not much to do with warehousing but involve rough terrain equipment -- there is quite a demand developing from concerns, such as contractors, concrete pipe manufacturers, lumber, and so forth, for trucks and fork lift trucks which will operate over rough terrain; and when they mean rough terrain, they mean something like the Aberdeen Proving Grounds of Maryland -- a truck will go up the side of a wall and still carry it's full rated load.

There are quite a few companies, including our concern, putting a lot of work into studying these rough terrain, multi-purpose vehicles.

Again, it will probably be the military that will show the greatest interest in these vehicles, along with these contractors and construction equipment manufacturers.

These three points I have brought out I think clearly demonstrate that there is a trend going on in the materials handling industry, whether we as manufacturers or users are aware of it, but that trend is the development of specialized equipment by industry for usage. It's changing gradually. Where Mr. Nicholson in his can plants uses equipment, somebody else can use the same equipment, such as a wholesale grocer or steel manufacturer, but the picture is changing. The can plants are requiring their own particular kind of equipment. The wholesale grocer needs another particular type. The steel mills need something else, and that trend is going to accelerate rather than go the other way.

Now, a few closing words on the subject of pallets and trends with pallet handling. We refer to pallets in the same terms as unit loads; they're both synonymous. I've always called the pallet as the wife or the father of the fork lift truck. Sometimes the thing turns out to be a grass widow.

There is an international organization known as the International Standards Organization, formed of European countries which have studied the problem for the past nine years, and they have come up with pallet standardization. These countries include such as France, Britain, West Germany, and Switzerland, and other nations such as Russia, Hungary, Czechoslovakia, and so forth. They were eventually

surprised that we had no similar organization in the States; and while we more or less go along standardizing pallets within our own circle and group, there has now been forming and functioning a pallet standardization committee sponsored by the National Standards Association and the Society of Industrial Packaging and Materials Handling Engineers. This group expects to come up with some pallet standards' recommendations sometime within the next 18 months.

There is also continued development on palletless handling. Mr. Nicholson touched upon it by mentioning some items as rams, clamps -- all manner of shapes and sizes of attachments which go on industrial trucks. I know the military, since their beginning use of industrial truck equipment has frowned upon hydraulic attachments of any sort on vehicles, but still the trend is to get rid of the pallet.

So, here we are. We have two opposing factors. We have one group establishing pallet standards, and here is another force trying to get rid of the pallet.

Now, I believe and I know that developments will continue on methods and ideas and equipment to handle material without any other allied piece of equipment, such as the pallet and the skid and tote box. Everybody talks about fork lift trucks, but we always seem to forget the old Easter bird that's with us, and that's the towing tractor. God bless them! There are plenty of them still in existence and still doing duty in warehouses; and I'll say this for tractor manufacturers: While we may have been asleep for a number of years, such is not the case any more. We recognize that there is still a definite need for tractors, and emphasis is being placed on developing better tractor equipment -- not only for the military, for the airlines and aircraft manufacturers, but all types of manufacturers -- principally those engaged in transportation activities.

5 of 5

Panel Session B-5 Wednesday PM Oct. 12, 1955

Resume of Materials Handling Methods in the Steel Industry

Wilbert G. Nichol, Assistant to Vice President - Operations - Steel, United States Steel Corporation

In steelmaking millions of tons of raw materials, such as, coal, ore and limestone are handled every year. In the process of converting these materials into finished products, they are, of course, rehandled many times. Steel ingots, the basic product of open hearth and electric furnaces and semi-finished steel in the form of slabs, blooms and billets weigh up to several tons each; therefore, the size of the unit load is a real factor.

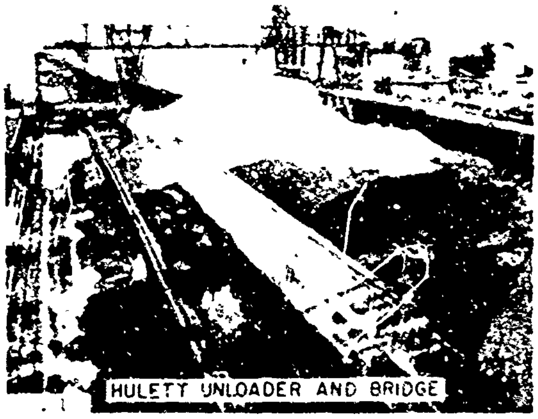
Materials handling in the steel business is obviously a large scale handling job and by necessity has for many years been highly mechanized. It would be impossible to move materials in a modern steel plant with only manual effort.

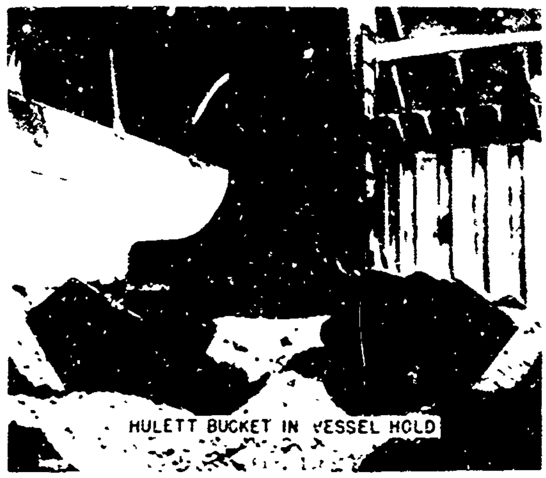
In general, the step-by-step improvements in steel making processes have resulted in a high degree of mechanized handling. There are three significant factors that have been largely responsible for this accomplishment. The first factor is the installation of new steel-producing units which are designed for higher speeds and greater capacity. In other words, the new equipment is faster and produces more tons of steel per unit of time. In order to maintain production, it was essential that improved handling be incorporated in the development of these modern facilities.

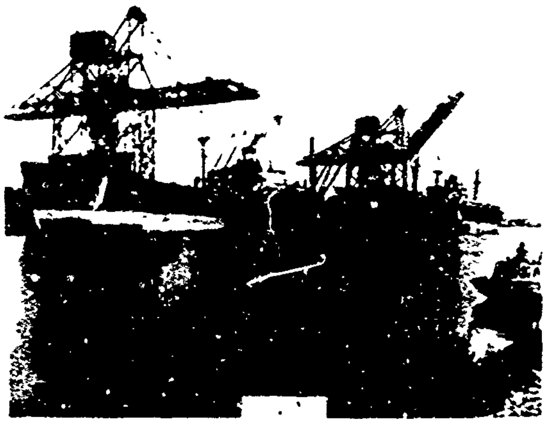
The second factor that has contributed to improved handling is the development and installation of automatic and semi-automatic controls to coordinate the movement of materials during processing and between operations. Such controls eliminate errors in judgment and provide a uniform flow of materials.

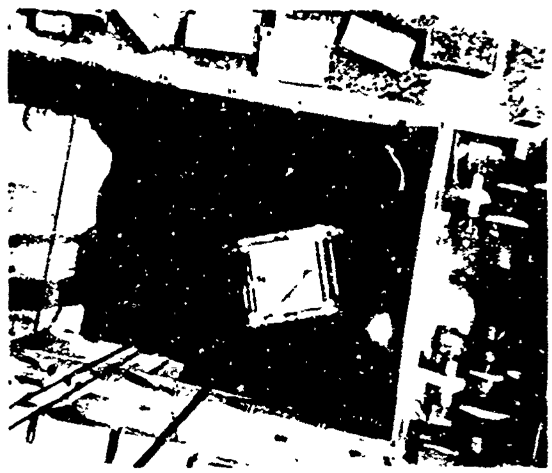
The third factor of major significance in better handling methods is the broad use of mobile handling equipment designed for specific applications. This type of equipment has contributed much to the effective handling of constantly increasing unit loads at maximum speed.

Now, I shall illustrate materials handling in the steel industry by a series of figures which have been selected as a typical cross-section of the wide variety of handling operations involved.


HULETT UNLOADER AND BRIDGE


HULETT BUCKET IN VESSEL HOLD





Mr. Wilbert G. Nichol Wednesday PM Oct. 12, 1955
Panel Session B-5

The unloading of iron ore from ships and subsequent stocking is representative of the raw materials handling problem. The bulk of the ore from the Mesabi Range is delivered to Great Lakes ports by ore carriers designed for this purpose. Foreign ores received at seaports is usually shipped in colliers or smaller Libery-type ships. The type of ore carrier used greatly influences the selection of unloading and handling equipment.

Figure 105

The Hulett unloader shown in the upper left-hand corner of this figure is widely used on the Great Lakes where ore ships have readily accessible hatches. This unloader oscillates in an up and down motion and is most effective on large ore carriers. The ore bridge used in conjunction with the unloader stocks ore for subsequent rail shipment.

Figure 106

This figure shows the Hulett bucket positioned in the hold of the ship. The unique feature of having the operator located in a cab near the bucket offers good visibility and positive control in unloading and clean-up operations.

Figure 107

One of the most modern ore handling installations is located at Fairless Works of United States Steel Corporation, on the Delaware River. Each of the two man-trolley type unloaders are capable of handling up to 1350 tons of ore per hour. The man-trolleys which operate on the bridges deliver materials into hoppers or directly to the ore yard. The hoppers are designed to feed into either railroad cars or to a conveyor belt. Note the hinged bridge that is raised to clear the ship's mast and rigging.

Figure 108

Unless ore carriers are available, the real problem, even with modern unloaders, is utilizing the buckets effectively. This figure shows a 15-ton bucket being lowered into the hold of a Liberty-type vessel. The small hatch permits only limited accessibility to the hold and requires trimming operations to move ore under the bucket. Trimming, which is done with bulldozers and slushing machines must be well coordinated to maintain maximum unloading rates.


Fig. 109

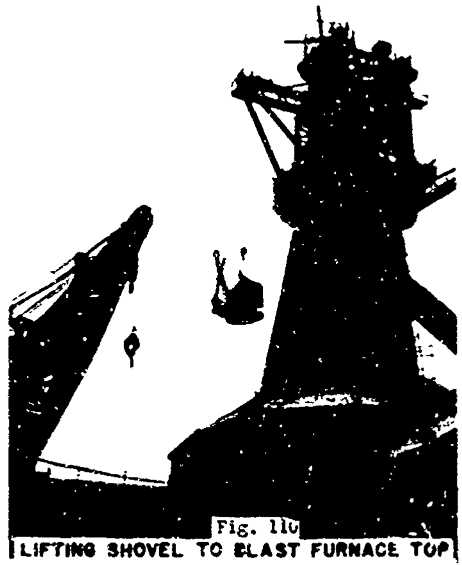


Fig. 110
LIFTING SHOVEL TO BLAST FURNACE TOP

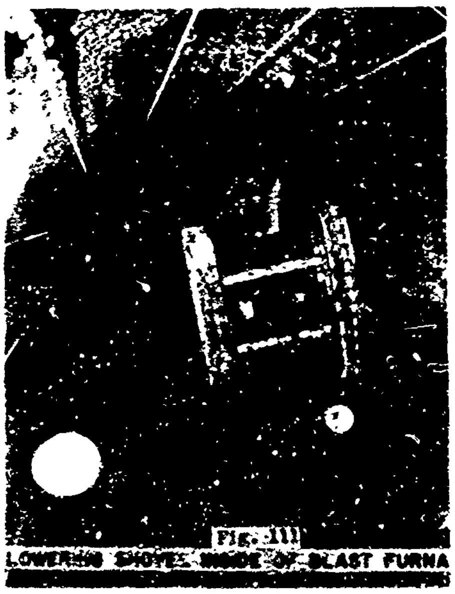


Fig. 111
LOWERING SHOVEL INSIDE OF BLAST FURNA


Fig. 112


CONVEYING COKE TO BLAST FURNACES
Fig. 113

Figure 109

This is a close-up view of one of the Fairless unloader hoppers that feeds a conveyor belt which is about 3600 feet long. The belt can be used to deliver ore directly to the blast furnaces or for stocking.

Figure 110

In blast furnace operations the removal of the worn refractory lining and installing a new lining is a major handling job. Even though the operation may occur only every two or three years, it involves many man-hours and iron production is terminated for a relatively long period. This figure illustrates a method one plant used to expedite the removal of debris and minimize manual handling. The caterpillar shovel weighing about 14 tons is being hoisted to the furnace top; from there it will be lowered into the stack for cleaning debris.

Figure 111

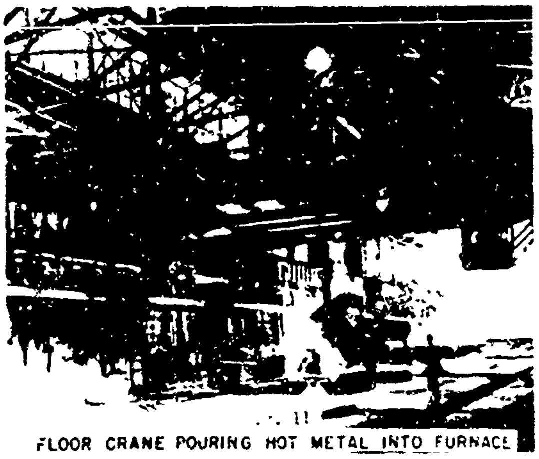
This view, looking upward from the furnace hearth, shows the shovel being positioned near the hearth where it will operate. The discarded refractory material will be shoveled into trucks or railroad cars for disposal.

Figure 112

After the old furnace lining has been removed, the fork-lift truck is another type of mobile handling equipment used as an aid in installing the new lining. Palletized bricks move into the furnace hearth on roller conveyors.

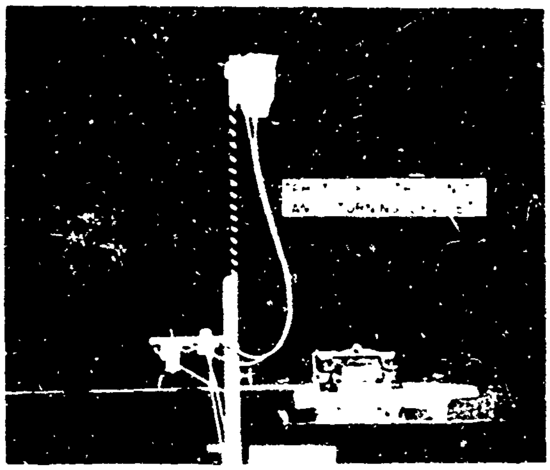
Figure 113

The movement of coke from coke ovens to blast furnaces is another bulk handling operation of major importance. In an integrated steel plant where coke is produced for only the blast furnaces of that plant, a conveyor belt such as that shown is the most effective type of installation. Because of the fragile structure of coke, rehandling and resulting fines or dust must be avoided as much as possible. When one large coke plant supplies coke for several steel plants within a district, the railroad hopper car is the conventional means of transportation.



FLOOR CRANE POURING HOT METAL INTO FURNACE

HANDLING PALLETIZED BRICKS BY FORK-LIFT TRACTOR



AUTOMATIC SAFETY TONGS, TYPE "A"

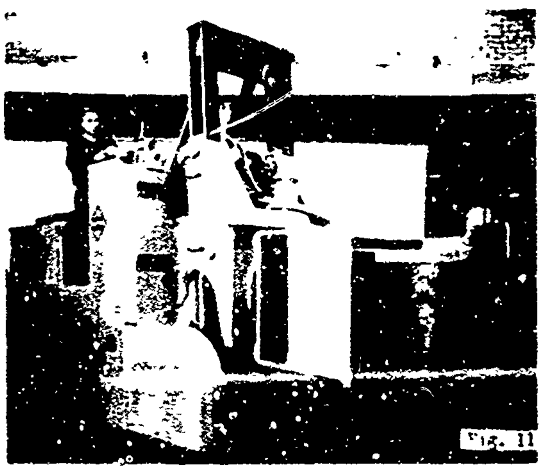


Fig. 11

Figure 114

This is a typical view of an open hearth furnace charging floor. An overhead charging crane is emptying a ladle of molten iron into an open hearth furnace. The scope of the handling problem in open hearth operations is indicated by the fact that about four tons of materials must be handled to produce one ton of ingots.

Figure 115

Palletized refractory brick handling is common practice in most open hearth shops today. This improved handling method has saved a lot of time and money and decreased furnace outage time. The high-lift type of truck shown is used to transfer brick pallets from the ground level to the charging floor level, a distance of about 20 feet.

Figure 116

In rolling mill operations, it is often necessary to turn or rotate hot billets and bars before entry into a roll stand. This is done for reasons of uniformity of heat distribution and to minimize certain defects. This operation formerly performed manually can now be done by means of the mechanical device shown on this slide. The cradle arrangement through which the billet passes is rotated by an air cylinder. The light rays emitted by the red-hot billet actuate a photo-electric cell which in turn causes the air cylinder to function and turn the billet.

Figure 117

In warehouse handling and shipping various types of cranes and conveyors are used for product handling. The overhead traveling crane with its capacity for extremely heavy loads is still one of the most widely used pieces of equipment. In the handling of large coils by crane several types of pick-up devices are used. The automatic safety tongs shown on this figure are a very satisfactory coil handling device. They are suspended from a crane and operate by simply positioning them on the coil and applying tension to the cable.

Figure 118

The heavy-duty coil handling tractor shown has been developed for moving and rotating coils weighing up to

Automatic Coil Tying Arrangement

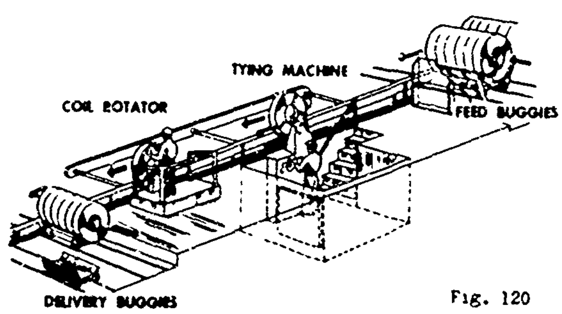
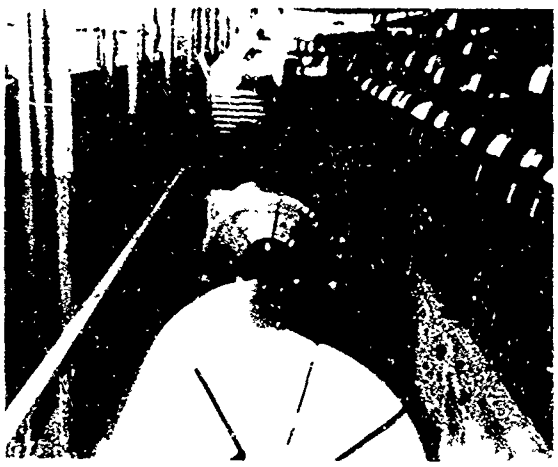
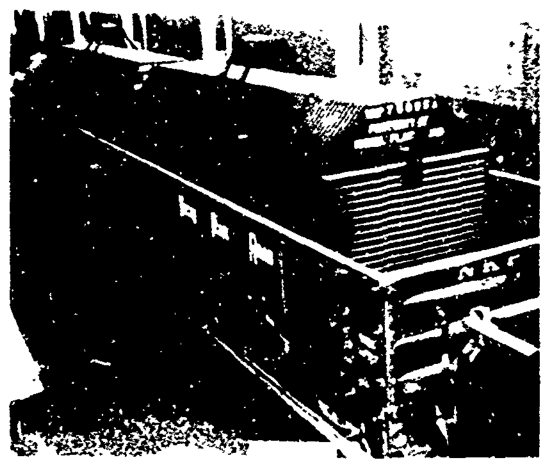


Fig. 120





15,000 lbs. The coil clamping and rotating mechanism eliminates the need for coil upenders or downtilters. Mobile equipment such as this has been effective in simplifying heavy coil handling.

Figure 119

This is another view of the same truck showing the coil rotated so that the axis is now in a horizontal position.

Figure 120

In the packaging field the securing of unit packages by wire or bands by manual effort is a costly and time consuming operation. The schematic sketch shown illustrates an automatic strapping line developed for cold reduced coils. The tying machine applies steel bands through the eye of the coil and performs the tensioning, sealing and cut-off operations automatically. Important benefits from mechanized packaging are less damage to product in transit and improved package appearance.

Figure 121

There is a trend in the steel business toward larger and heavier coils for customer processing. This trend has brought about a need for unusual care in shipping method to prevent damage in transit. The special gondola car shown has been developed for shipping coils weighing up to 20 tons each. This particular design provides two floating sleds formed to support the load. The sleds move within a limited distance but spring bumpers absorb heavy impacts at the ends of the car. In the background are portable metal covers used for weather protection.

Figure 122

Here is another view of the special gondola car showing the metal covers in place. In addition to the elimination of blocking materials and the savings in loading time, these cars deliver the product to customers in excellent condition.

Figure 123

This figure shows another unusual car loading job that may be of interest. A special flat car was necessary to

handle this wind tunnel plate assembly for the Air Force. A depressed section of the car extends the full length of the plate assembly. The structural steel bracing and packing materials were necessary to maintain alignment and protect the highly polished plate surfaces.

This is the concluding example of representative materials handling operations in the steel industry. The scope and magnitude of the problems require continuous effort in an already highly mechanized industry.

Automation In Warehousing

Mr. A. K. Strong
Materials Handling Specialist, American Cyanamid Company

The word "automation," when it is used properly, as was originally used in Ford a few years ago, applying to the tieing together of various manufactures of motor parts, made sense. I'm afraid we're using it somewhat like the word "chlorophyll" was used a few years ago. We're trying to cover quite a multitude of things, and we're not doing too good a job. We're blaming everything on automation.

This particular presentation involves a typical chemical plant. Now, this is just an ordinary plant out in Western Pennsylvania that had several component units in itself -- that is, there were several processes put into that plant for the making of various products -- and because that plant was managed by good solid chemical engineers, a word about the process and about the outturn and about the yield, and not too much about how things got here and back again.

As each individual process grew, they had to use wall stretchers and things like that to get the thing in proper focus. They used about a half million bags, and had an output of something around a hundred million pounds of product. A lot of those raw materials did come in in bulk form, but a still higher percentage came in bags, drums and carboys; and they did require about 5,000 ordinary 4 x 4 wooden pallets for handling in-plant storage. There were six manufacturing areas in this operation. Originally, the plant used two separate shipping and receiving areas. There is a very good reason for that, because these were the only two buildings in the plant that had floors built to the ordinary height of the boxcar and to the ordinary truck. All the rest were down on the ground.

The plant had no central warehouse as such. Raw materials and finished materials were stored inside, outside, and all over the place; and they spent a terrific amount of money in moving stuff from here to there and through the process.

In the operation used, they thought they were pretty well mechanized. About 1943 they put in fork lift trucks and pallets, but they didn't go all the way. There were places where the fork lift truck carried a pallet to a point, and then they took it by the hand from there.

For moving materials between buildings, we found a terrific collection of highway trucks, each manned by a crew of three men -- the driver and the helper and then the third man that did the work. Each of these trucks was equipped with a power tailgate. The idea was that you could put any kind of a commodity on the tailgate and raise the thing up or lower it, whichever way it was going, and then you were in good shape.

I have actually seen stuff dumped off a pallet, loaded on, and carried to another point, and then unloaded -- one drum at a time.

I might add there were quite a few of these vehicles, and, incidentally, quite a few men.

Now, if I can just have that first picture. I'm going to run through these rather quickly.

Figure 124. This is a small operation, but it was typical. We had skids along the building, and you might find two or three drums along the side after the drumming operation. They rolled the drums up to this platform and then upended them by hand up to the wooden pallet.

Figure 125. This is another typical operation. The fork lift brought a wooden pallet, loaded the bags to the tail end of the highway truck and then the men buggy-loaded the bags one at a time into the truck. The same thing was done with the loading on a car.

Figure 126. As an approach to this problem, we took a drawing of the plant and we interconnected -- the point on the building on the map from which the material was moved. We converted everything to unit loads and decided that the unit load would have to be used somehow, and then expressed the volume by varying the width of line between the various points.

We showed this picture to the plant manager and he said, "My God, that can't be our place!" "Well," we said, "it is." There was a terrific movement of drum materials in one area and a similar movement both ways of bag materials being shipped and raw materials sent back in another area. The rest were more or less incidental compared to these two.

After we analyzed the situation, it appeared that we might do something about it. First of all, we might eliminate

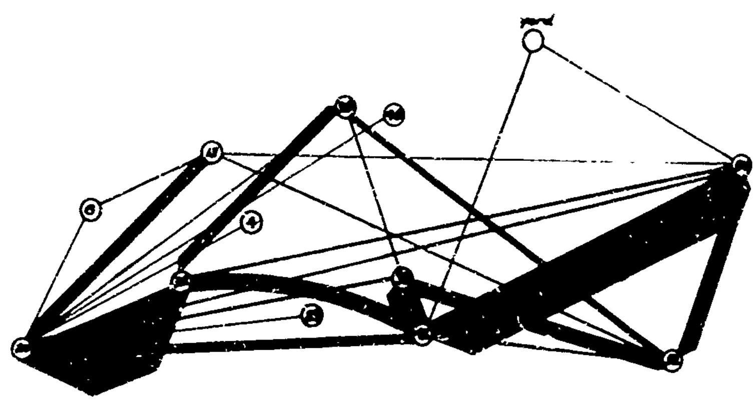


Fig. 126

Existing System - Quantities Handled Monthly

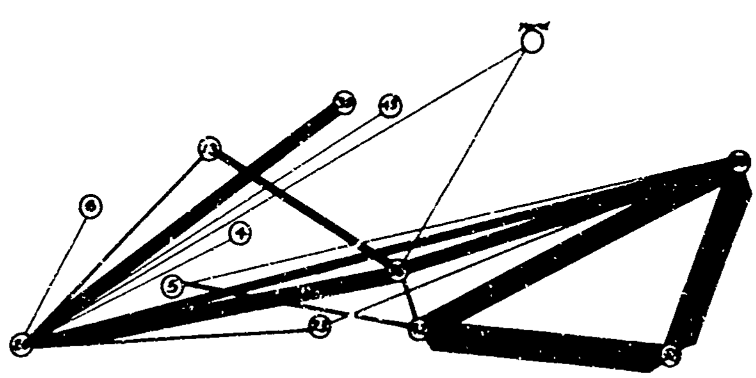


Fig. 127

Proposed System - Quantities Handled Monthly

one of the receiving and shipping areas and make just one. We could also install a means of internal transportation that would really do the job with a minimum of people and also a minimum amount of movement. In other words, let's say that the cheapest materials handling at all there is in the world is just no handling at all -- move it but don't touch it.

Figure 127 is what we proposed.

By this reorganization, we got rid of quite a few trucks. We also found another thing in this operation. Each of these buildings that were used as storage areas had a warehouseman. All we could find out is that he carried a little black book in his pocket and he would tell the fork lift operator or the truck driver where to get various materials in and out. We decided that the best thing to use was a trailer train system (Figures 128 and 129). The one difference between this trailer train and most others we've seen around the country is that it was self-loading. It doesn't require the services of another fork lift or other power equipment at the various buildings. These buildings didn't all have such equipment. We had ground-level operations and we had some areas fairly adjacent to the manufacturing area where it was necessary to actually store material, so this means of transportation had to be self-sufficient.

We therefore selected two 6,000-pound lift trucks and 12 trailers. We used strings of four, as a rule, and would usually have an extra pair for each train, if necessary.

We equipped these trains with two-way radio control. Instead of operating on a regular schedule, we tied in with the dispatcher, who used to ride around the plant grounds in a Ford truck, trying to find a truck to do the job. Now he sits behind a desk and he's gaining weight, I'll admit, but nevertheless he has at his fingertips charts on all of the storage areas in that plant. In other words, when a train-load of material is moved to storage, he tells the operator where to place it. When it's placed, the operator calls back that it's so many drums of such and such a material at this location. He has an actual running knowledge of material at the plant at all times at his fingertips. The other two boys at the fork trucks and with the trailers do the rest of the job.

Another one of the problems we had after we integrated this operation was the handling of drums. Remember, we had two shipping points at one time. Then they reduced it to one, which meant that sometimes we had as much as a thousand

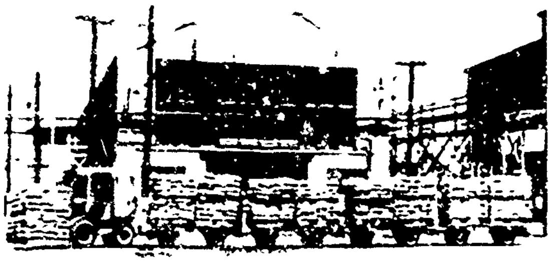
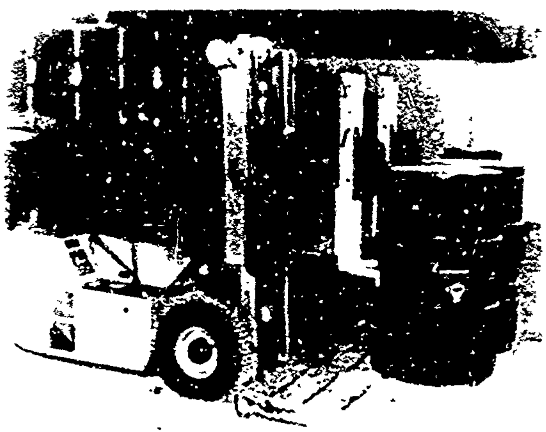


Fig. 13[illegible]

Fig. 1[illegible]

Fig. 133



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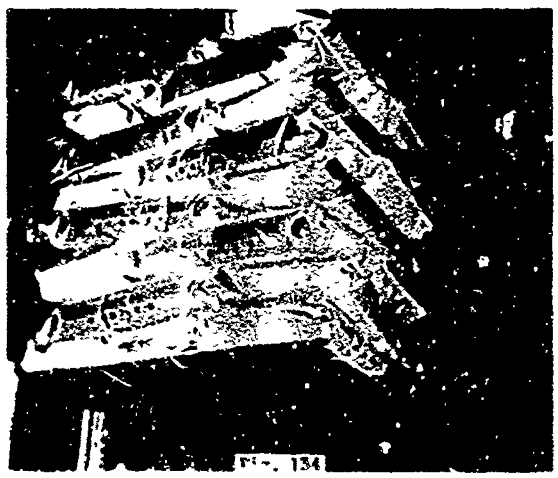


Fig. 134

drums to be shipped through one building in one afternoon; and this plant being remote from Pittsburgh, the trucks would not drop their boxes. They simply insisted on coming in 3 o'clock in the afternoon and taking their load then. The result was we had to ship out a thousand or five hundred drums in two or three hours, or else put out extra shifts. We selected the Liftomatic drum device (Figure 130). When we mounted it on a hydraulic lift truck, we went one step further so that we could reach across the pallet and get the second two drums. By extending the grippers forward of their normal mounting position (Figure 131), we reached the second two without going around the pallet. Feeding it with another truck from the warehouse, we can load four drums a minute with two men. That includes the necessary stencilling, shipping records, and so on.

In loading a car or a truck, you do not always load your drums tight together. Figure 132 gives you a better idea of how a truck can be loaded — two drums inside, the next two outside and the next two inside, and so on. This same kind of an item will hand[illegible] packs. It will handle any type of steel. We're usi[illegible]s in production and, incidentally, several of the oil companies have taken quite an interest in the idea. Two of them wanted to know if we had it patented.

The next problem we had was handling the bag material. This plant produced about 50,000,000 pounds of bag materials, and they had previously been stored on the wooden pallets and then buggy-loaded into the carriers.

We had quite a few customers who wanted palletized shipments. We couldn't find any good simple solution to this problem because some of the shipments had to be double-tiered in order to get the minimum tonnage in, so we developed a pallet of our own, which consisted of kraft paper with two spiral tubes or sleeves on either side. Figures 133 and 134 show the pallet and a typical load being handled. We have been shipping all of our output from that plant by this method during the past year.

To go back to recap., our labor picture when we started the job was as shown in Figure 135.

Figure 136 is what happened to it when we got through. We're coming down on the calories a little bit!

Figure 137 shows what happened to our operating costs. At the left is the original way of doing business, yard-handling,

Existing System - Handling Labor Required

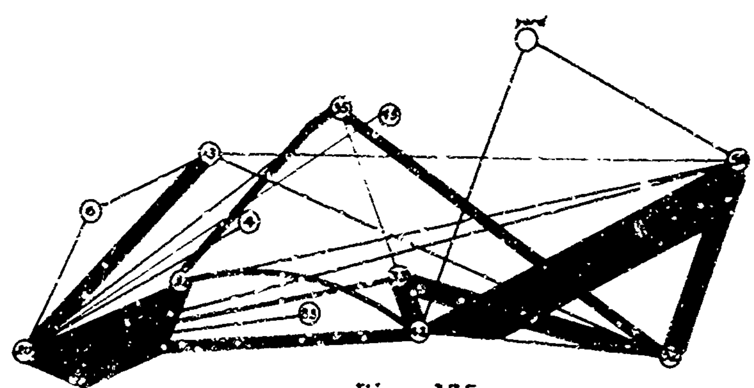


Fig. 135

Proposed System - Handling Labor Required

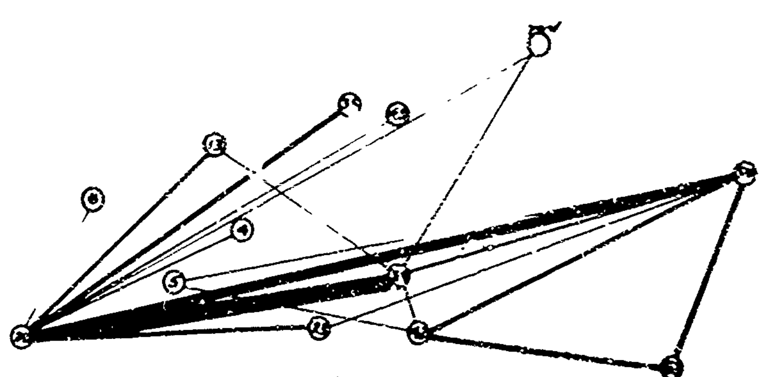


Fig. 136

shipping. The new picture is at the right. We cut just a little over 50 percent out of the operating cost for handling within that plant.

One of the after -- what do you call it when you fire a big gun -- concussion afterwards; is that what it is? -- the thing that hits you after the gun goes off -- in other words, one of the concussion waves that came from this development was the paper pallet which I just showed you.

We have learned from actual experience over the last two years, using this particular pallet method, that we can enjoy a 50 to 75 percent reduction in unloading and warehousing costs. Where we ship out materials to other customers, depending on the type of loading facility which we have, we do or do not save any money using the pallet. If it's a conveyor-loaded operation, even a toothpick would be an added expense, but where we warehouse and then ship, we more than save the cost of the pallet for our own uses.

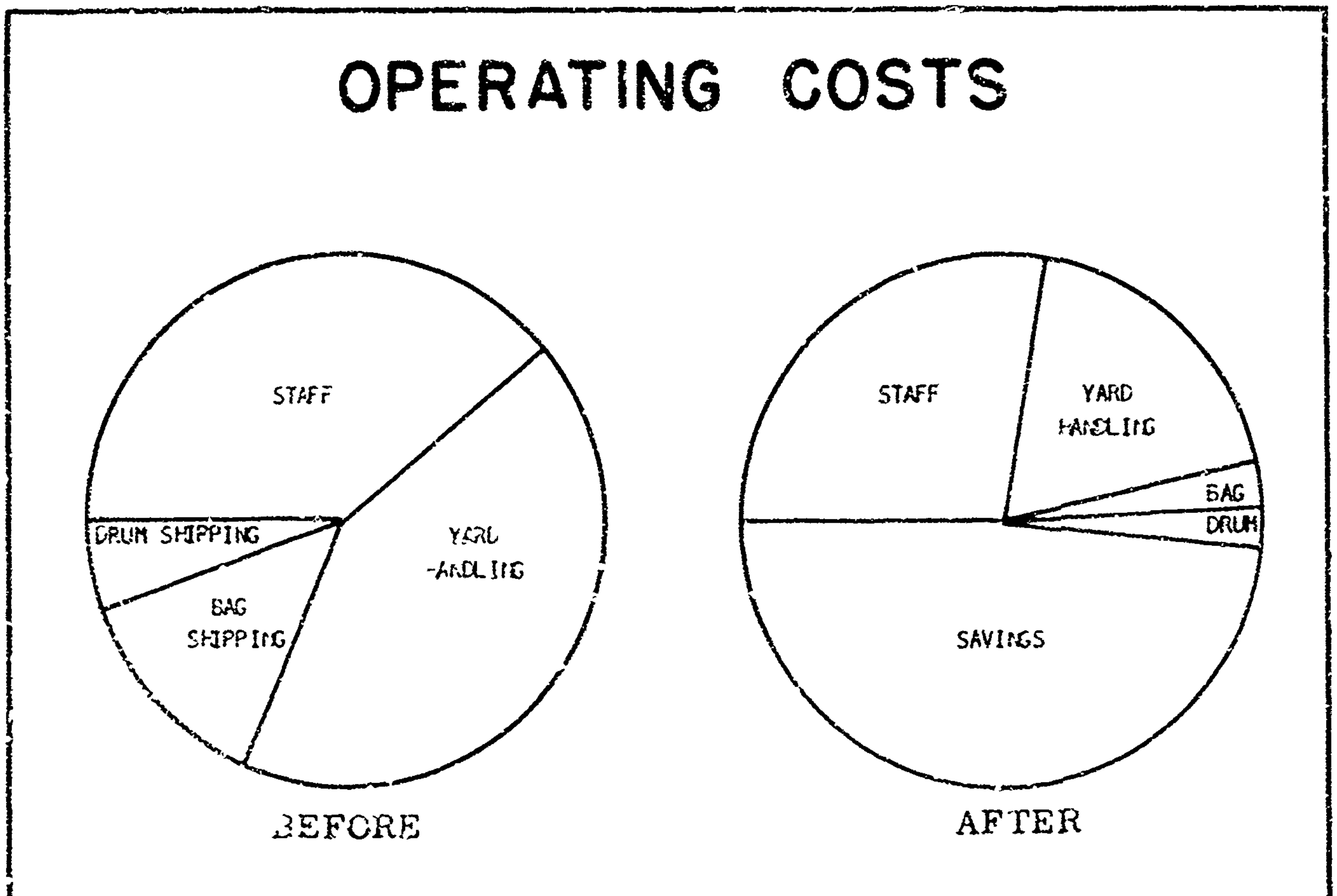


Fig. 127

The Age of Attachments

Mr. O. B. Carliss
Director of Engineering, Yale & Towne Manufacturing Company

Like Mr. Johnson, I'm going to try, in an effort of keeping time down, to give you a little word picture of where we, as manufacturers of handling equipment, feel that we're going with these developments in materials handling.

In materials handling, it is not possible, in most instances, to apply complete, or anywhere near complete, automation. It's entirely a matter of degree. The economic law of diminishing returns applies in the application of automation to materials handling just as well as it does in any other type of industrial analysis.

Generally, the material to be handled is so diversified that any one technique or system will only solve a small portion of the total problem, and you cannot afford the capital investment that would go with applying the best of automation techniques to your entire problem.

The present period in the design and development of fork lift trucks has been called the age of attachments. Attachments are devices used in conjunction with fork lift trucks and show the degree of automation that can be practically applied to the solution of some of these problems.

A few years ago, attachments were being applied to approximately 10 percent of our own gas and electric truck shipments. Today, better than 25 percent of the trucks being shipped from our plant are equipped with attachments, most of them being hydraulic in their operation, and this curve continues to rise at a steady rate.

Now, just for a moment, let us look at the later development in fork trucks first and then turn to the newer attachments, because I feel that the two go hand-in-hand. The latest thing to hit the gas truck field is an automatic transmission, a torque converter transmission, developed by practically all of the manufacturers of gas trucks and marketed by them. It is intended primarily for high-cycle operation where the problems of driver fatigue enter the picture.

If you've ever driven a fork truck for eight hours, or for an hour, in a high-cycle operation with plenty of

changing your directions, changing your speed, hoisting, tilting, lowering, maneuvering, you will find that the torque converter -- the automatic transmission -- which eliminates the need for clutch-pedal operation, is of vast help in speeding up this operation.

We have spent considerable time and effort in the development of time studies, and that in itself could be the subject of a long dissertation.

Another application which is gaining widespread attention is LPG, the application of liquified petroleum gas to fork trucks, which is going on at a considerable rate. Why? Because it gives us less maintenance. We are definitely finding that the use of the dry gas fuels is a contributing factor to longer engine life, less maintenance cost, lower down time.

Now, higher lifts are coming into the picture. Today it's common practice to stack 2500 rolls of paper 28 to 30 feet in the air and do it safely. That's a far cry from the 12 feet that we generally consider for this type of vehicle. Naturally, it requires some type of modification in the design. Higher lifting speeds are definitely in the cards. The lifting speeds are going up, and most of the manufacturers are providing trucks in the range of two to six thousand pounds' capacity with lifting speeds somewhat on the order of 40 to 45 feet per minute.

In electric trucks there has been a very interesting battle of design within the warehousing field in the short-coupled rider stacker as compared with the efforts of several of the manufacturers of electric trucks to a considerably reduced over-all length electric truck of the three to four thousand pound class. At least two manufacturers today can offer an electric truck of the 4,000-pound class, what we have considered the normal standard in the past.

Considerable interest is being shown in side loaders, not of the outdoor operating type but of the indoor operating type, in areas where the loads are long, primarily cylindrical. I think that the electronically controlled tractor which follows a wire or painted line is definitely a step toward automation, finding its primary application in warehousing, in order picking, which is a tremendous problem, a problem for which many solutions have been proposed -- none of which have been completely satisfactory.

They go all the way from the completely automatic warehouse, which Mr. Meserole has so ably suggested, which is completely punch-card system controlled, and he has proposed a warehouse that will handle the items commonly found in supermarkets, ranging from a nine-inch square cube for a box of spice to a three-foot cube for a box of paper towels or toilet tissues, most of your paper napkins coming in that size also. He proposes to distribute these by punchcard, delivering them to palletizing machines which will be capable of handling the various sizes and combinations.

However, as I said previously, the law of diminishing returns applies, and you can come along with this electronically controlled factor and order pickers; and in an existing building, you can do a substantial job of reducing your man-hours per ton mile.

I think it would be remiss to not mention the safety devices which are coming to the forefront today. Primarily among these is the safety seat in a fork truck, both of the gas type and more commonly of the electric type, where when the operator leaves the truck, the power in the case of an electric truck is disconnected and the brake is applied; and in a gas truck, after a given period of time, the engine is automatically shut off, the brakes being applied immediately when the operator leaves the truck. If you've ever operated on the piers and watched those men jump off the truck and watch that truck plunge down the Hudson River, you'll know what I'm talking about. You will also know if you had to fish out the truck and get it back in operation.

Also the question of travelling at high elevations of lift -- at least one of the major users of fork trucks in the country today insists that the truck be used, equipped with a device that will permit operation only in first speed if the load is more than 24 inches off the ground. The newer types of examples with newer types of facing materials -- you saw some examples of that. You saw the Liftomatic drum-handling attachment with a clamp being used with what many of us would call a fork positioner, a means for positioning the device to catch hold of the barrels, regardless of their diameter.

Some of you may be familiar with the so-called ream clamp, which had flexible arms and pads to conform with the package. There are other competitive types of clamps to that on the market doing a very presentable job. One is the

development of new synthetic friction materials which are coated on to the metal pads, rather than using rubber pads which are put on with some adhesive, or this friction material which the Navy has been using in some of their chutes is finding a place as a covering for the clamp arms; paper roll clamps, now commercially available clamps, which will reach from 10 inches to 60 in diameter; paper rolls without manual adjustment, and up to 6,000 will be capacity; lumber handlers for sideloading piles of lumber, as into a truck -- not the straddle-loading which you saw pictures of, but the device on the forks of a truck which will permit you to come into a stack of lumber in a normal manner and then discharge it from the side of a truck into a car or a truck.

You have already seen the barrel clamps of the Liftomatic type. I think another interesting device of a similar nature is a clamp which catches the barrel and which permits forward dumping in some barrels and side dumping in others.

Particularly important is the handling of chips and the processing of materials. I think one of the interesting applications is the handling of hams, where they pick up these half tubs of hams and dump them forward into the brine.

The Pull Pack, which was patented by the Clark Equipment Company, and under which most the fork truck companies license the paper pallet and the gripper combination, is finding considerable interest. I think as people get more familiar with this operation, they will learn the value of this particular device, and it will come into even greater popularity.

The handling of this new collapsible rubber container which is coming on the market is presenting some problems, some of which are being solved by the use of a gooseneck boom mounted on a standard truck. Interestingly, just before getting started, one of the gentlemen here asked me, "When are the fork truck manufacturers going to put sideshifters on all their trucks?" Personally, I can't think of a more important feature in the general handling of material. If you've ever tried to stack material and do a good housekeeping job -- particularly as the heights of stacking get higher -- the value of the sideshifter becomes increasingly important. It is available I think, by all manufacturers for all types of attachments on their fork positioners where you are handling a multitude of sizes.

I know there is a tremendous desire to standardize pallet sizes, but the difference between the desire and the

fact has to be recognized if you're in materials handling, the fork positioner is your means to afford quick and easy shifting of your forks from dimension to dimension to several sizes of pallets.

Now, there is a whole field of specialized container-handling which can be characterized by the handling of refrigerators, stoves, or home appliances, where a specialized type of clamp, rotator, and sideshifter is used, which permits loading freight cars with the first rows vertical and the upper row being put in horizontal.

The magnetic tinplate clamp is a good example of the developments which we are experiencing in this field. It's always a problem to handle tinplate because it must be handled carefully. It must not slide piece on piece as it is being handled, otherwise you will scratch the tin or the lacquer or whatever the material is that is printed on it, from an appearance standpoint; and all in all it becomes a pretty tricky material to handle. It has been handled successfully in the past.

The first fork truck, I think I can say, in the development of this whole fork truck industry, stemmed from the handling of tinplate. The first fork trucks ever built were forks adapted to a platform plan to stack one skidload of tinplate on top of another, but the earliest tinplate clamp trucks were built to apply pressure on the top of the load in order to keep the stack from sliding; and the latest are built the same way, with one exception. This magnetic tinplate clamp using power from the generator on the gas truck, or the battery in the case of the electric truck, holds the tinplate in position while it's being transported, and then proceeds to reverse the current to discharge the load when you're ready to set it down.

The problem of turning tinplate ov · between operations involves both the clamping and rotating mechanism. That we have not been able to solve magnetically and still resort to mechanical equipment.

I could go on here for a long time, but this is just a thumbnail sketch of developments which the industry has come forth with. There are many others on the boards, and most of these developments stem from the requirement, from the need, from the man who says, "I have a problem," and I think

that there is no field of activity alone, industrially, where the need, the necessity, is more the mother of invention than in the development of these new attachments for fork lift trucks.

Panel Session B-5 Wednesday PM Oct. 12, 1955

Materials Handling As An Extension of the Production Line

Mr. J. E. Cave, Supervisor, Research and Development Section
Materials Handling Engineering Staff, Ford Motor Company

It's a pleasure to be with you and be part of this symposium. I was happy to accept Mr. Nicholson's invitation to participate because I am a sincere believer in a sound interchange of ideas by men with a common problem, although it necessarily must be attacked in a different manner in diversified industries.

Too often we are inclined to be so wrapped up in our own activity that we don't take time to see what the other fellow is doing in his backyard. This is especially true of material handling, the so-called newborn babe of the manufacturing field, which is constantly being clothed with new ideas. Here are definitions of two different aspects of handling that are grouped under one heading in some companies, but are classified as separate entities by Ford Motor Company.

"Material handling" is the actual handling, transporting, and storing of stock. It is a production control function.

"Material handling engineering" is the engineering or developing of methods and equipment, and the establishing of standards, procedures, and policies for the application of the methods and equipment to transporting, storing, and handling operations. It is a manufacturing engineering function vested in a material handling engineering department.

We sincerely believe these two definitions create two singular tasks which are most effectively accomplished in our company by separate organizations: (1) one of which deals with control, (2) another which deals with engineering.

I have the assignment of chasing the never-ending ramifications of No. 2, the material handling engineering -- that is, handling from shipping dock to receiving dock to the first operation, and from the last operation to storage and shipping.

We consider material handling engineering an extension to the production line, and, in keeping with modern concepts and the topic of this panel, we attempt to mechanize handling

to the fullest extent possible in keeping with practicality and sound economic analyses.

This principle of "Material Handling as an Extension to the Production Line" calls for sound planning. It means the same type of engineering that is given to production processes, plant layouts, machine tooling, et cetera. It calls for a material handling plan for each plant on an engineered basis, and then a close follow-through to see that the plan is maintained and is effective.

Here's an example of what I mean:

We standardized on three basic types of durable containers -- the corrugated metal bin box, the collapsible wire container, and the tubular metal rack.

We used these container standards as the basis for our industrial fork lift truck standards. We found that the 4,000 pound, the 6,000 pound, and the 7,000 pound fork lift trucks would accomodate desired container loads for practically all of our handling operations.

We then developed standard gravity-roll loading and unloading stations and concurrently engineered standard gravity-roll installations for our highway carriers. These stations and truck installations accomodate the standard containers.

At each shipping and receiving point, there are two platforms on which two sections of roller conveyors are mounted like rails. These are properly spaced to fit the runners on the standard containers. One of the conveyors slopes downward to carry outgoing shipments; the other has a reverse slope for unloading. Both conveyors have counterbalanced hinged portions which adjust to the height of the truck floors.

Matching conveyor strips are installed in the van trailers. Approach ramps are engineered to put the trailer at the proper angle to receive or discharge a load.

This engineered combination of containers, industrial trucks, loading and unloading stations, and gravity-roll equipped van trailers has permitted us to mechanize practically all of our interplant handling in the Greater Detroit area.

Containers are positioned at the use point by fork truck. They are mechanically or hand-loaded, depending upon the economic and practical factors involved. They are picked up by fork truck and carried to the loading station.

The fork truck positions the container load on the station. When the station is filled, an operator releases an articulating device, which rolls the load into the equipped van trailer. The load is transported to the receiving plant, where it is rolled on to an unloading station. Containers are picked off by fork truck and taken to the use point. Empty containers are refilled with parts the receiving plant ships to other plants, or empties are generated to the loading station for automatic transfer to a shipping plant.

There are approximately $5,000,000 worth of containers used in the interplant moves. An investment of that size demands control. Therefore, we established a somewhat unique centrally controlled durable container program. Note that I used the word "durable." Our objective is to use durable containers wherever possible. Wood containers, which were once very common even in intraplant handling, have been replaced by durable metal containers which cost much less per years of life, and which also eliminate safety hazards to men and materials resulting from broken boards, splinters, and pulled fasteners.

These are the advantages of our centrally controlled durable container program:

The container flows are established so that containers are moving in scheduled movements and are kept under load to the fullest extent possible.

The usual bill-in, bill-out procedure between plants is eliminated.

Purchases can be made by a central source in large quantities with consequent price advantages.

The containers are repaired at a central source, and maintenance can be scheduled and controlled.

Misapplication of containers is curtailed.

This program is administered by our Material Handling Engineering Staff Department. All plants must complete

container surveys which are verified by both receiving and shipping plants. The application of the container to the part and quantities per container are checked by the staff department. The Production Control Department verifies container floats, and establishes a container distribution schedule to properly sequence container movements from plant to plant. The material handling engineering staff allocates containers to using divisions, and container expenses are prorated to the various divisions on the basis of allocated use.

This program has been in operation for several years and has been very successful. It has been expanded to include supplier movements so that automatic handling can be realized from the vendor's production line to our own.

For instance, brakes are manufactured for us by the Kelsey-Hayes Company in Jackson, Michigan, which is approximately 65 miles from our Rouge Plant. Brakes are placed on our Ford-owned standard rack pallets, picked up by fork trucks, transported to our Rouge area plants, removed by fork truck, and conveyed directly to the use point. We allocate the rack pallets to the Kelsey-Hayes Company on a deposit-rate basis with dollar adjustments made every 60 days.

They are happy with our type of rack, and we realized a substantial piece price reduction in recommending the use of the centrally controlled rack in lieu of a pallet pack which they formerly employed.

A good example of a mechanized extension to the production line involving centrally controlled containers is reflected in the shipping of forgings from our Canton, Ohio, plant to the Metropolitan Detroit area.

The hot forgings are positioned in special hot metal containers which are set aside for cooling.

They are then transferred into these collapsible wire containers and fork trucks place the container loads on specially equipped flat-bed rail cars.

The cars are received in Detroit, unloaded by fork truck, and taken directly to the production operation or placed in interim storage. When positioned at the production line, they are positioned on tilt stands, which permit work-

level feeding by machine operators.

Another example of automatic handling as an extension to the production line is portrayed in engine shipping. The engines used to be mechanically placed on conveyors with an air hoist and conveyed to the shipping dock. They were then taken off the conveyor by air hoist and placed in a cradle. They were manually taken from the cradles and placed on two-wheeled dollies and rolled into the car.

They were then manually positioned on end-in trunnions and locked in position. The engines were shipped in a semi-completed condition, without carburetors, generators, et cetera.

Today the full dressed engines are carried by power and free conveyor to a location adjacent to the rail dock. They are automatically positioned in specially engineered railroad-owned shipping racks. The rack is then automatically transferred by roller conveyor to a flat-bed station, where it is tiered. The tier is picked up by fork truck and placed in a rail car.

The loaded engine car is then shipped to our branch assembly plants.

As I mentioned in our opening paragraph, the things that we achieve in different companies are done in different ways with the same results.

The racks are unloaded by fork truck. This multiple handling device removes the railroad-owned rack complement of engines and positions them in one of our standard racks. The engines are then conveyed by fork truck to the use point. Again, an automatic extension to the production line.

I might add that this automatic handling was made possible by the fact that engine-design considerations were given to handling and shipping. Special concessions were made in the design of the engine for the sole purpose of economic handling.

The factor of correlating design with shipping and handling is too often overlooked or sluffed off by responsible people. Many times, a material handling engineer is given a part and told to ship and handle it. Design has reached a stage where it is too late to change. Had the material handling engineer been given the opportunity to

comment, he might have effected a substantial savings by recommendations that would not defeat product performance. Perhaps a primary commandment of product design today should be: "Thou must engineer for shipping and handling." I say "primary" because material handling represents to us 20 percent to 40 percent of every manufacturing dollar. That kind of money warrants design consideration.

An example of design consideration plus automatic handling as an extension to the production line can be portrayed by roof handling and shipping.

The roofs used to be designed with the cowl, front and rear windows as component parts of unit design. They were hand-placed on conveyors, transported to shipping docks, hand-removed from the conveyor, carried into a railroad car, and hand-placed in special dunnage installations.

Now, the cowl and window frames have been removed. The roof comes off the press line and is placed in a shipping cradle. The cradle is picked up by fork truck and carried directly into a railroad car, where it is locked in place. At the opposite end of the line, fork trucks with a sling attachment remove the roofs and place them on a dolly. A tow tractor conveys them to the use point.

We can load approximately 1,000 panels in a conventional railroad car as opposed to 100 which could be loaded in the specially equipped cars by the old method.

Again, this automatic extension to the production line was a result of good product design.

I'll close by saying I am personally a little perplexed by the varied meanings that have already been given the word "automation." This was actually a Ford-coined word, used to explain refinements in production planning which have been taking place for years. "Automation" is just a word to explain the normal evolution of recurring technological improvements. It applies to all technological improvements in production tooling as well as the continuing improvements we are making in our material handling equipment and methods. It is the result of proper planning, improved tooling and the application of that tooling to the best possible advantage. All of the hullabaloo we hear about automatic plants can be placed in the same category as the Army without a foot soldier. It just won't win.

Plant Layout as it Affects Material Handling

Mr. L. J. Bardsley
Director of Customer Service, Johnson & Johnson

Although this panel is concerned with automation and the machinery of material handling, I would like to talk on plant layout as it affects material handling.

Early in my working career, I spent two years with two different companies, working on the design of conveyors. During these years and since, I have seen many cases of conveyors being used as an excuse for poor layout. In other words, the conveyor was installed to move something from where it was to where it should be, whereas if the layout had been correct, it would have been where it should have been in the first place.

Conveyors are an example of one of the many material handling tools available to us. The point I am making is that frequently material handling equipment is used because the material is not where it should be and through good layout the use of material handling equipment can be minimized. For that reason, I would like to spend a few minutes here speaking on the subject of plant layout as it affects material handling.

I am going to speak about our experiences at Johnson & Johnson, because I think it will be more interesting to discuss actual cases than theory. Johnson & Johnson distributes its products to domestic customers through four warehouses located at: New Brunswick, New Jersey; Chicago, Illinois; Dallas, Texas; and Menlo Park, California. Menlo Park is located just a few miles below San Francisco. Our Menlo Park plant contains our newest warehouse or shipping center, and I will confine my talk to the layout of that plant. This Shipping Center was put in operation a little less than a year ago.

In shipping to our customers, about 28% of the cases are picked and handled in pallet quantities. About 70% of the cases are picked as individual cases. About 2% of the cases we ship contain items being shipped in less than case quantity or what we call "loose goods."

In designing a shipping operation, one of the first things that must be decided is whether you will fill your orders by picking stock from the warehouse, or whether you wi[illegible] stablish a picking line. The advantage of establishing

a picking line for filling orders is that the order picker is required to walk or travel less distance to obtain the stock to fill the order. On the other hand, an additional movement of stock is necessary as the picking line itself must be filled with bulk quantities from the warehouse. If you have a great many items and small quantities of each of them, it usually pays to pick directly from the warehouse. In our case, where we have relatively few items and relatively large stocks, it pays to establish a picking line.

Figure 138 shows the layout of our picking line. There are a number of things to be considered in designing a picking line. This particular line was designed with three matters uppermost in our minds:

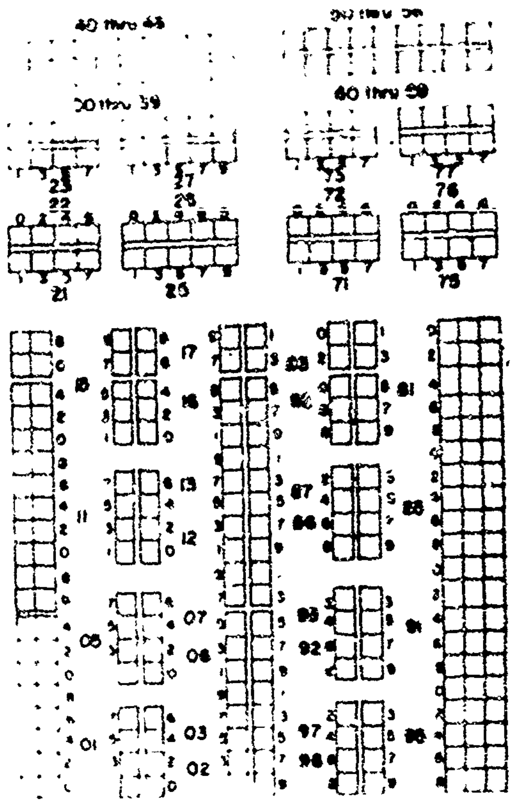
1. Short walking distance on the part of the order picker.

2. Careful consideration of the activity of each item in the line in respect to its position in the line and the quantity of stock to be stored on the line.

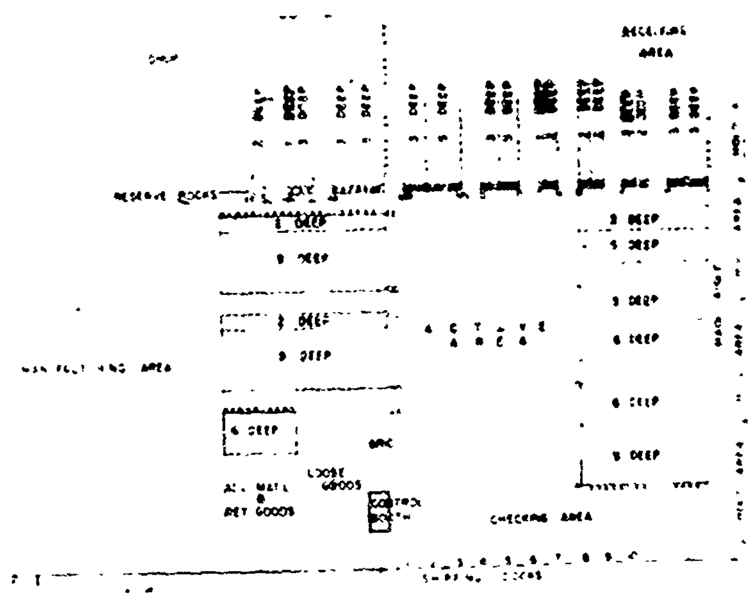
3. The use of minimum floor space consistent with the volumes to be handled.

A man filling an order normally passes through this U-shaped path, which is a short distance to travel, considering all the stock that he passes. On the outside of this path there are pallets of stock on the floor. These represent our largest volume items. You will notice that on the left there is room for two pallets on the floor, and, on the right, three pallets on the floor. Fresh stock is supplied from the outside aisle, whereas orders are being filled from the inside aisle. By this arrangement the men doing the picking are not interfered with by the delivery of new stock, and the stock is rotated because it is being picked from one side while it is being supplied from the other side.

On the inside of the main picking line, there are pallet racks with a pallet of the same item in both the top and the bottom positions. The case picker is normally selecting stock from the bottom position, but there is extra stock on the top position so that he is not delayed by running out of stock. The next slower moving items, or our "B" items, are put there. On the back aisle, there are pallet racks on either side. In the bottom position are our next slower moving items, or "C" items. In the top position are our "D" items, still slower in movement. In the very back of the picking line are the slowest moving items, known as "E" and



PLAN OF
MENLO PARK ACTIVE AREA

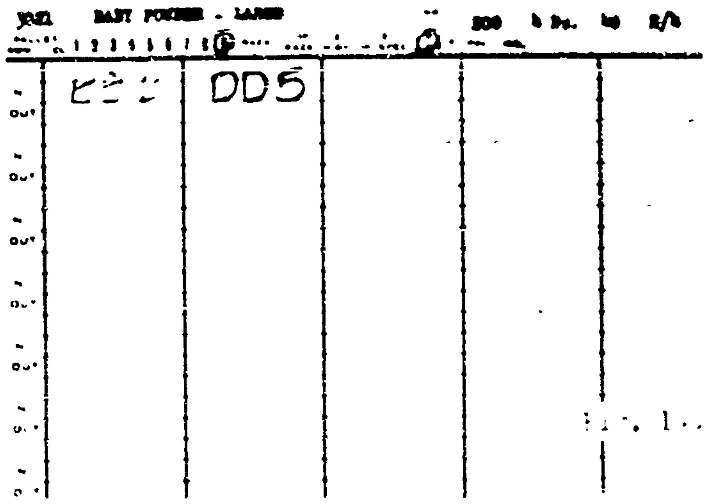


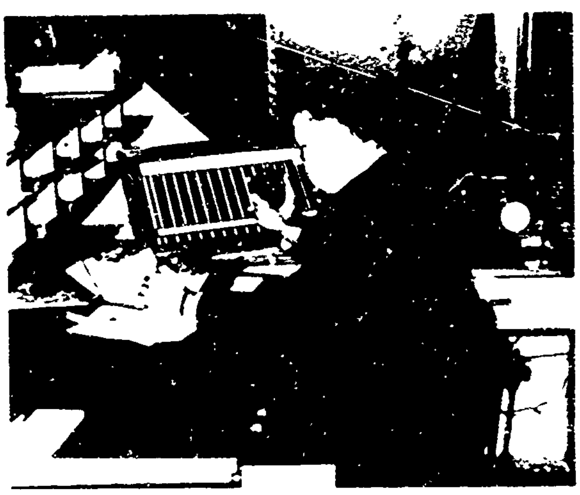
and "F" items. The items are thus positioned in six categories, based on their volume of movement. The case picker with his truck normally stays in the relatively short main aisle from which he can pick about 80% of the cases to be shipped. He can obtain another 18% of the cases needed by taking short cuts to the back aisle. Orders for stock from the back aisle usually amount to one or two cases only. He would normally go to this aisle, obtain the stock and carry it to the truck which he has left in the main aisle. It is rarely necessary for the case picker to go to the extreme back of the picking line, as the movement of these items is such that they are normally shipped in less than full case quantity.

Figure 139 shows the layout of the shipping center in which our picking line is installed. Having designed this case picking area, we next wrapped the warehouse around it. Stock coming into this plant by rail is stored on the right-hand side of the warehouse. Stock to be manufactured in this plant is stored on the left side of the warehouse.

In all our warehousing operations, we are very fussy about the proper rotation of stock. We, therefore, like to have any one item stored in at least two-pallet rows so that we can remove stock for shipment from one row and place incoming stock into a different row. Calculations were made to determine how deep the pallet rows should be for storing each item which we stock. We found an interesting thing in making these calculations in that the calculations proved in most cases that we should use shallower depth rows than we would have assumed just through experience. We would have assumed that the deeper the rows within reason, the more economical, as they consume less aisle space per pallet stored. Calculations, however, showed this not to be altogether true. If a row is designed to hold nine pallets deep and three pallets high, there would, of course, be twenty-seven pallets of stock in the row when filled. To obtain rotation, we empty a row completely before putting any more stock in it. It follows that in the case of the nine-deep row, twenty-seven pallets must be consumed before this space is available for any other stock. A row one-half as deep would, of course, be available twice as fast.

You will notice that the aisles on the other side of the warehouse have been given double letters. The pallet rows are numbered. If a stock has a double letter and a number, it is known immediately that it is on the left side of the warehouse.


DD5



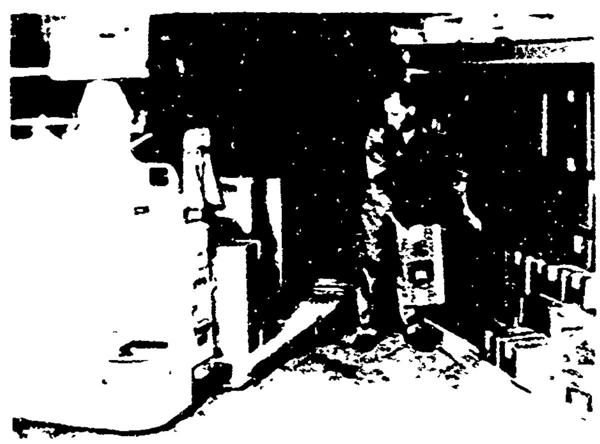


Figure 140 shows our stock locater card. When an item comes into the warehouse, this card is referred to by product number. On the card is circled the most economical depth pallet row for the storage of the particular item or if it were a very small running item a pallet rack would be designated. This particular slide shows that this item should be stored in a nine-deep row on the left-hand side of the warehouse. The left-hand side, which contains double-lettered aisles, has been designated by circling the double X's on the card. Other pertinent information is contained on this card, including the pallet pattern as shown in the extreme right-hand corner. We have standardized on our pallet patterns to facilitate interplant shipments and so that pallet quantities can be given on customers' price lists for products which move in pallet quantity.

In entering the rows where the incoming stock is to be stored, such as "BB2" and "DD5" as shown on the sample card, a different colored pencil is used each month. When stock is called for, the oldest row of stock is, of course, used up first. When a row is completely depleted, it is crossed out again with the colored pencil being used that particular month. Thus, by looking at these cards and the colors of the entries, you can see the month that the stock first started to go in a particular row and the month that the stock was depleted from the row.

All our fork trucks are equipped with radios. When a row in which a fork truck is placing incoming stock becomes filled, the fork truck operator calls the stock locater clerk on the radio. A new row number is given to the fork truck and entered on the card by the stock locater clerk. Likewise when a fork truck takes out the last pallet of a row, he calls the stock locater clerk by radio to inform him that this row has been depleted so that it can be crossed off the card.

Figure 141 shows the stock locater clerk looking at his stock location cards and talking to one of the fork trucks over the radio. The peg board which is seen behind the stock locater's right hand represents all the pallet rows and pallet racks available in the warehouse. When a peg is in the board opposite a particular pallet row number, it indicates that that row is empty. When an empty row is assigned for incoming stock, the peg is naturally removed. When a full row becomes empty, a peg is, of course, replaced in the board. In addition to the radios, this man also has a two-way intercom system connecting him with the picking line. There are

several microphones located in the picking line so that a case picker can talk to the stock locater clerk from any position in the picking line. This is used so that if the stock picker notices some of his stock becoming low in spite of routine replenishment, he can inform the stock locater clerk, who will dispatch new stock to the line by calling one of the fork trucks on the radio. This stock locater clerk also handles the bills of lading which you will notice in the pigeonholes in front of him.

Figure 142 shows the truck used by the case picker. After the picking line was designed, equipment had to be selected upon which to assemble orders. Everything from hand trucks, pallet movers, dragline trucks, tow trains, and radio-controlled trucks were considered. We found through synthetic time studies that a truck which would handle approximately eighty cubic feet of stock would be most efficient for our particular orders and this particular picking line. It was for this reason that this truck, which holds two pallets, was chosen and specially built for us.

Case picking assignments are, therefore, made up in multiples of eighty cubes. A large order could call for several trips. As many as five smaller orders could be made up into an assignment for one trip. The largest order is placed on the bottom, the next largest order in the middle, and the small orders on the top and so positioned in a rack which is seen on the truck so that all the information which the case picker needs is available to him without shuffling any but the smallest orders.

Figure 143 is a view of our loose goods picking section. You will notice that the stock is held in quick pick bins. It is fed from the back and delivered by gravity to the front. The advantage of these bins is that a maximum number of items can be made available to the man picking the stock in a minimum walking space. In adopting these gravity feed bins in place of shelving which we used previously, the distance to be walked in selecting stock was cut in half. One man both picks and packs the loose goods stock needed to fill an order. He is the only one that ever sees it. There are no checkers or inspectors. We feel in general that industry has taken too much responsibility from the worker. These men know that they have the responsibility to fill the order properly and if an error is made, there is no question as to who has made the error. They feel the responsibility and very few errors result.

We use IBM tabulating equipment to type our invoices and shipping papers. The tabulating cards are prepunched both for customer information and for product information and are stored in "tubs" for easy selection. There are a number of advantages to this system. One is that much of the work is done in advance of receiving the order. The customers' cards contain the correct name and address of the customer, the routing, the salesman's number, territory number, class of trade number, etc. All this is prepared in advance and prechecked to make sure that it is right. The same is true of the product cards. They contain the correct nomenclature for the product, the cost code number, the location of the stock in the picking line, the correct price for the particular class of trade, the weight of each case, the freight classification, etc.

Figure 144 shows a shipping order which has been edited and is ready to be sent to the Shipping Department. On the second item of this order the customer has ordered twenty cases of four oz. cotton. There are twenty-four cases of this item on a pallet. It is obviously cheaper to remove four cases from a pallet of twenty-four rather than pick twenty cases from the case picking line. This order has thus been edited so that twenty cases are not picked from the case picking line but rather a pallet of twenty-four is obtained from the warehouse and the fork truck operator on his way to the dock drops four of the cases off at the picking line position. These large volume orders are stored as mentioned before on the outside aisles of the picking line so that the fork truck, in doing this, is not interfering with the case pickers. The third item on this order calls for eighty cases of Baby Powder. In this instance, forty cases are stored on a pallet and the order has been edited so that two pallet loads are delivered to the dock.

In addition to the above, cases and weights have been added by freight classification so that the bill of lading can be prepared. You will also notice on the top of the order some entries which indicate the number of cases to be delivered to the dock by pallets, the number of cases coming from the picking line, the number of loose goods items, and the number of pallets. These are all used for an independent cross-check when the order is stencilled and checked at the docks. The red tag pinned to the top of the order is to indicate that there are pallet movements on the order. The warehouse location of the pallets must be entered on the order when it arrives in the Shipping Department. This flag makes it unnecessary to examine all the orders to find which ones contain pallet movements.

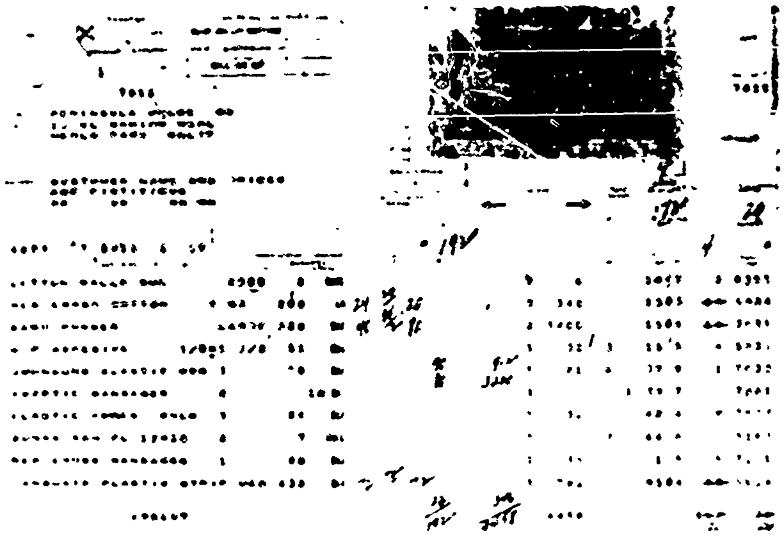


Fig. 144

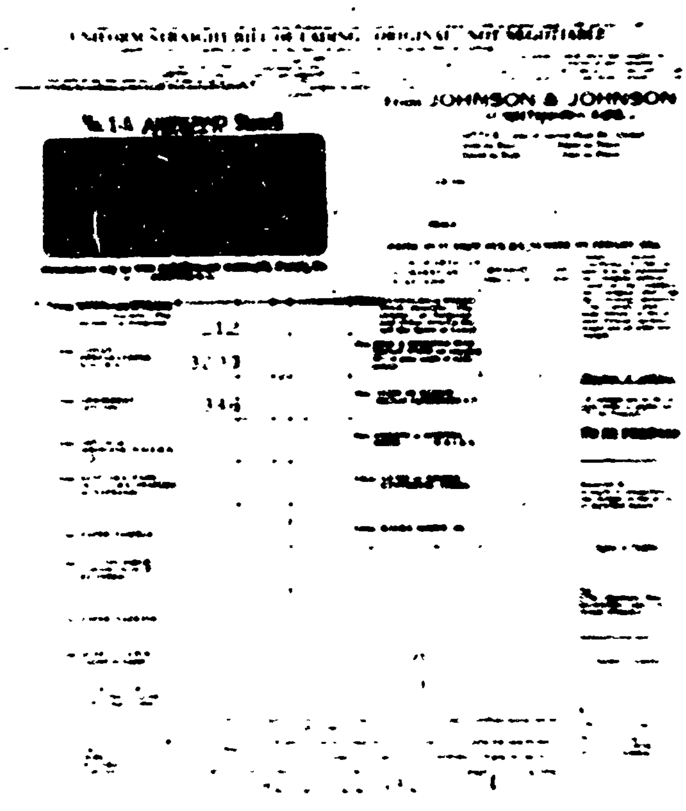

JOHNSON & JOHNSON
[redacted]

Fig. 145

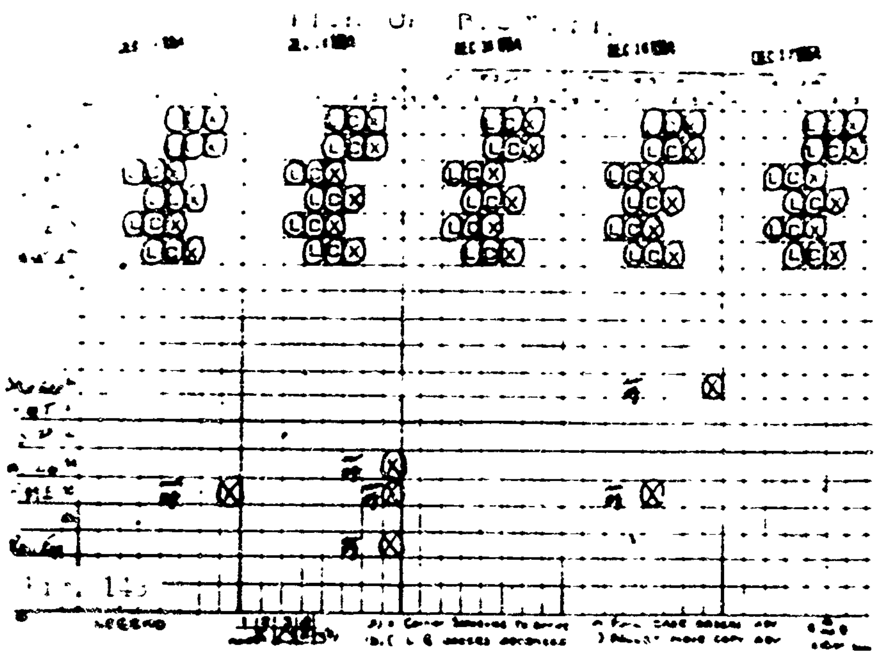
Figure 145 shows our bill of lading. You will notice that a stencil has been attached to it. In one typing with an electric typewriter, the stencil is cut and the bill of lading is headed. It is interesting to note that our order number and our bill of lading number are identical and that this number is also cut on the stencil. This makes it very easy to check any question about a shipment. There is no need for cross references between bills of lading, orders, etc.

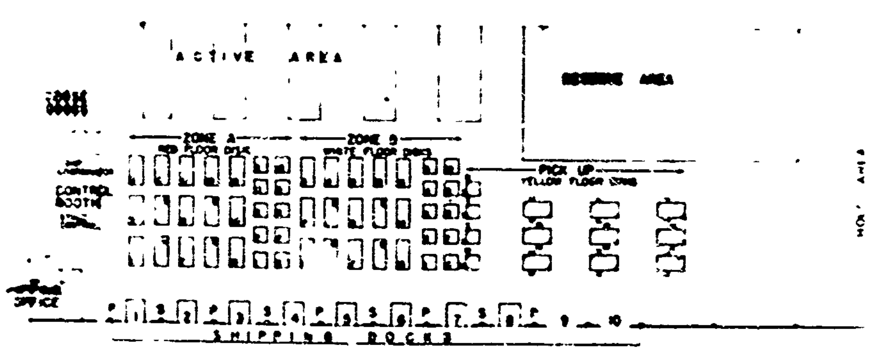
Orders are sent from the office to the Shipping Department via a pneumatic tube. It probably would have been cheaper for us to deliver the orders once an hour by a messenger the short distance to the Shipping Department. This, however, would put a batching operation in the flow. If orders were sent to the Shipping Department once an hour, the lucky order would get there immediately, but the one that has just missed the messenger would be delayed one hour. The average order would be delayed one-half hour. By installing this pneumatic tube, on the average, one-half hour is saved in our shipping time as compared with hourly messenger delivery.

Figure 146 shows a specially designed office on the shipping floor. These two supervisors run the whole warehouse. The man on the left, you will recall, runs the stock locator system. He also supervises the fork truck and receiving operations and has all the contacts with the outside truckmen. The man on the right does all the scheduling and is responsible for the assembling and checking of orders. This office is at a location where the loose-goods packers, the case pickers, and the fork truck operators moving stock to the dock can conveniently get their assignments. The procedures are interesting but too detailed to describe at this time.

Figure 147 shows a close-up of the scheduling desk. Most of the bins shown represent carrier routings. I might add that we use as few carriers as possible consistent with good service to our customers. We prefer to give the few carriers that we use good quantities of business so that they are interested in giving us good service. A number of areas are shipped in full trailer loads only.

Figure 148 shows our pick-up blotter. Our major carriers keep empty trailers in our dock doors at all times and are represented on this sheet. The regular pick-up carriers which come in each day are shown at the top of this form. The "X" under a number is the time the carrier is due in. The "L" shown two hours before the "X" is the time that loose





PLAN OF
MENLO PARK CHECKING AREA

Fig. 139

goods should be scheduled. The "C" shown one hour before the "X" is the time case goods should be scheduled. As these operations are completed, the "L," "C" and "X" are circled. If the carrier was due in at three o'clock and did not get in until four, the circle would be placed under four o'clock. At the end of each week, the sheet goes to the Traffic Manager, who, at a glance, can see if the carriers are coming in on time. At the bottom of the sheet are shown carriers which are only called in on occasion. The wiggly line shows the time the telephone call was made to the carrier. Under it is the initial of the man making the call. The "X" shows the time the carrier promised to be in and the circle shows the time the carrier actually came in.

Figure 149 shows the layout of the dock area. Zones "A" and "B" are where orders are placed to be checked and stencilled prior to loading into trailers of our major carriers. These trailers are parked in doors 1 to 7. The pick-up area on the right feeds orders to pick up carriers loaded at dock 8, although 9 and 10 are available. The floor spots in the pick-up section where the orders are checked and stored to await the pick up are coded. This location code is entered on the bill of lading so that when the carrier arrives, the man on the dock knows immediately where the orders are for this carrier.

Figure 150 shows a shipping order completely checked and includes at the bottom the date and the time the order was actually shipped. This paper is sent back to the office by way of the pneumatic tube to release the invoice.

Figure 151 shows a trailer being loaded. The dock board is of interest. It operates hydraulically and moves in and out as well as up and down. You will also notice that the board is made up of individual fingers. These accomodate themselves to a truck which is not level due to a soft spring, tire, or uneven loading. This board was originally designed by Johnson & Johnson, though it is now manufactured by an outside supplier and available commercially.

This plant has turned out to be a very efficient one based on the actual cost of its operations during the first eight months. Although it handles substantial volumes, a minimum of material handling equipment is needed because careful attention has been given to its layout.

New Concept in Distribution and Warehousing, Calumet Industrial District Project - Something New in Freight Cars

Mr. Irving M. Footlik
President, Footlik Associates

I am glad Mr. Bardsley went ahead of me here. One reason for that basically is that I want to give you a realistic approach as to how to make the building he showed you, an automatic warehouse, how it might be done and how you might lead up to it.

First of all, I have had the assignment in the last few months to look into the crystal ball and prophesy what is going to be needed in 1965 and develop automatic warehouses for that period. To do that we have to use the realistic attitude in that general direction and if you are to take what is available to you today in the way of automatic pallet holders, automatic pallet unloaders, in the way of accumulator conveyors, selective chutes, fork trucks, automatic order releases and one more that I'd like to give you, which was just introduced yesterday, which is the pallet retriever, then we actually have the facility to make the automatic warehouse and make it today the thing we might like to have in 1965.

To go about doing it we have to know something about the facts that we have to work with: One, how much of each item is produced? Two, what period of time is provided to produce this material in? Third, is production consistent? And, four, how much will our anticipated sales increase within the period of the next ten years? And there we are really looking into the crystal ball.

Now, we also need one more figure and this one is changing every day. In an operation such as he showed you, you will find the amount of time he can shift a full carload or truckload is rapidly decreasing. The method of purchasing is such that we want more turnovers which means they are taking less in each time and handling operation, less in the warehouse, so as a result of that you will find from LCL and LTL standpoint usually the percentage; and this is the percentage taking over the candy and some of the drug industry. It is running in the ratio of 60 percent on small orders and 40 percent on full car-truck loads.

Now, the next thing is the number of items we have to handle, and the last is to reduce that to how many of those items that we have to handle are fast enough moving that we

can put them in our automatic setup.

Now, I will try to develop right in front of you the automatic warehouse and how it can operate and then reduce it back.

Our so-called automatic warehouse is fed from our production lines. At one end of the warehouse and under closed docks we would have a series of trucks, our closed truck docks. Our rail siding would be along the edge. We start feeding in this building from the production line. When we start out we go to case loaders in boxes. They are spread out and go in accumulator conveyors which are directly above storage. In other words, these are hanging from the ceiling. With the high storage method today we can use the high ceiling inside our entire warehouse area.

From the accumulators we go off on right angles or straight. When we go off straight we go into chutes or selective slots. These selective slots hold the items which we have to ship and they are able to accumulate as much as 100 to 120 items per slot.

Items are released by means of electrical impulse or mechanical releases and one man can push a button or use the card that he had his order written on, to automatically release the items he wants in the amounts indicated on the order. As the items travel on the delivery conveyor other equipment applies the address stencil and the order continues and goes right out into the truck.

When slot units are full, we route the overflow around into automatic pallet loaders. From this point the fork trucks take the commodity and set it in the storage areas, which could be anywhere within the building proper in this manner.

Now, if there is an item that comes off the production line only one day a week, naturally we're going to need to replenish our operating stock from the palletized reserve. To do that we have a pallet unloader, which feeds into the slot units.

These units here will hold the equivalent of a pallet load of merchandise.

Now, when we have to ship out in the manner of a truckload or carload, we would use a pallet retriever which will

take the pallet, shoot it out from under the load, hold the load right on the fork itself, go in the truck and push the entire load off the forks onto the truck or car. An installation of this type runs $250,000.

We have a system that is flexible. As far as the automatic stuff is concerned, we can make it as automatic as we want to fit the time or period of year we want. If we change products, it is very easy because all we have to do here is change whichever slots they are going into.

So that is how you can take and make an automatic warehouse a reality and you can make it a reality for now, for five years from now or ten years from now, and pretty soon you will see a few of these that are taking place.

Management today is trying to look into the future. In one instance, one of these units will be set down in the center of 265 acres of land, with the idea that the manufacturer is going to build his entire system of plants around this unit feeder to take advantage of savings.

This entire system is planned to operate with no more than five people when it is entirely mechanized.

So much for that.

We have something we have been working out for the last six months. Many of you have gone through the process of trying to unload a boxcar and handle goods in boxcars, so you will be interested in this.

It is a railroad car with overhead garage doors on the side. You can get into it right from the side and take your goods out. Each of the compartments is the exact width of a highway trailer. We in essence have five highway trailers set side by side pulled by a railroad engine. Each of these compartments in turn can be divided. The interior of this car is white plastic, the exterior is red plastic. As far as dust and filth that you see ordinarily in these cars, you won't see it here.

The other thing we might convey is that ordinary boxcars are designed to take 100,000 pounds of weight. This car, being used almost exclusively for food stuff or bag materials, we distribute that 100,000 pounds over the entire car, so we require less steel understructure than you

need in the ordinary boxcar.

This car, with a series of doors like this, comes pretty close to the cost of a regular car with only one door in the middle.

Figure 152. Looking down at the car from the top, shows the way the interior is lined up. You can go in like with a highway trailer and then dividing the compartments with a piece of corrugated so the items don't interlace.

One thing that we have to watch is that the cases are not allowed to be loose. That is why I asked the question in another session as to what they were doing to try to avoid such difficulties. Yesterday in Chicago, without any rehearsal whatsoever, this car was unloaded in 11 minutes with two fork truck operators before an audience of 1100 people.

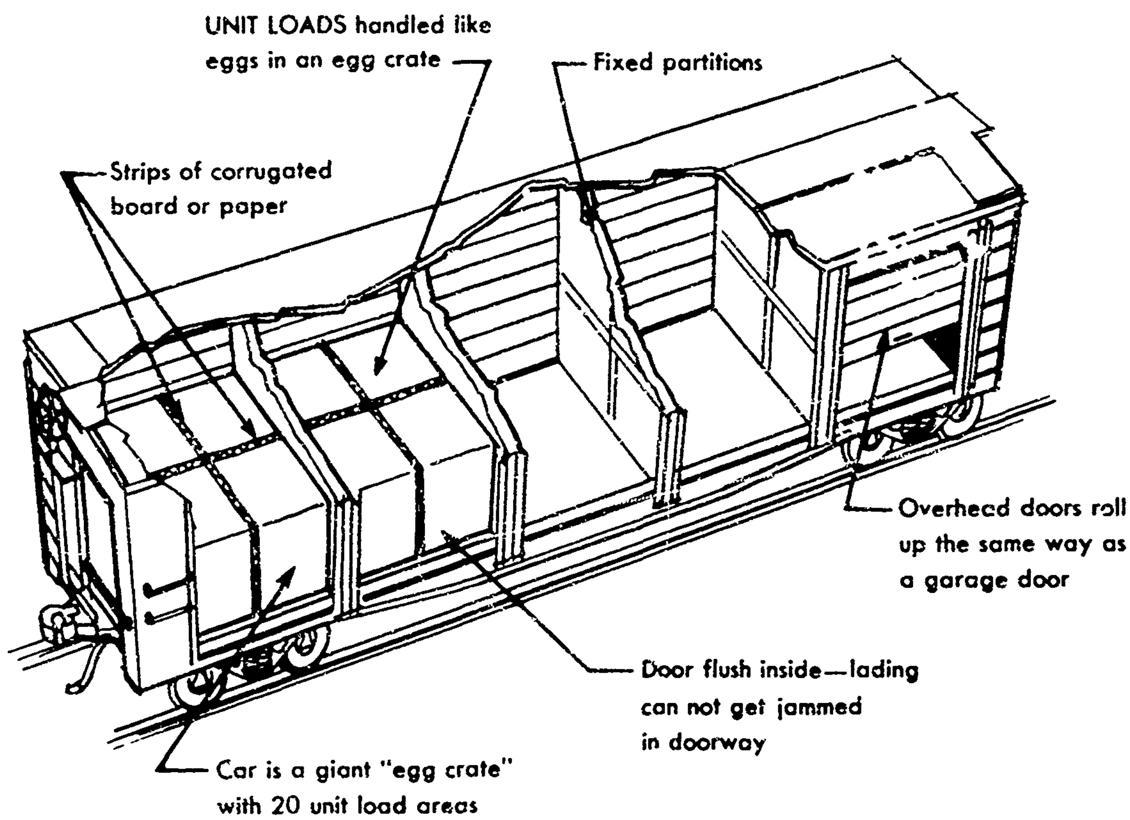


Fig. 152

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Afternoon Panel Session

Wednesday, October 12, 1955

B6. Administration of Packaging and Materials Handling Programs
Chairman, Dr. John Immer
Work Saving International

The relationship of the packaging and materials handling functions and means of proper administration in both government and industry.

Panel Session B-6 Wednesday PM Oct. 12, 1955

Administration of Packaging and Materials Handling Programs within the Navy

Mr. C. K. Hall
Office of Naval Material, Department of the Navy

It has been said that the best way to develop an understanding of a subject is to explain it to someone else. When the subject involved is as complex as the structure of a military organization and as vast as required by the magnitude of government operations, the project becomes one of gargantuan proportions either to understand or explain. Rather then expend your valuable time with a detailed resume of Navy organizational structure, I am going to attempt to disect the goliath and bring forth a few of the more important facts which are essential to a basic understanding of how we operate and why we do it that way.

As the topic assigned includes the administration of both packaging and materials handling programs, the first thrust of my hypothetical cleaver will be to separate these two and bring the packaging facet to the light.

Since the disasterous revelations of material deterioration early in World War II, which were mentioned by Mr. Pike on the first day of this Symposium, the Navy, along with the other military departments, has maintained an active packaging program. As recently as July 28, 1954, the Secretary reaffirmed the responsibilities of the various elements of the Department of the Navy in this important insurance type program. The Chief of Naval Operations and the Commandant of the Marine Corps head up the planning staffs which determine the operational requirements of the fleet. The Chiefs of the several technical bureaus develop and procure the equipment (ships, planes, guns, etc.) needed to fulfill the established operational requirement. The Chief of the Bureau of Supplies and Accounts, as head of the Navy's integrated supply system, is responsible for storing and maintaining supply support of the material developed by the Bureaus and accepted by the planning groups. The Chief of Naval Material, in whose office I am employed, is responsible for the establishment of overall policies concerning the production, procurement, and storage maintenance of the Navy supplies. Intertwined in the whole operation is the Navy Packaging Board, which serves in an advisory capacity to the Chief of Naval Material and tends to consolidate and coordinate the thinking and actions of the technicians employed by the various bureaus and the Marine Corps. The organization which develops a new equipment is responsible for determining the packaging requirements of the material it develops. This is essentially the organization of the Navy for equipment development, supply and packaging.

Before it is practical to bring a similar picture of the materials handling program into focus, I must take another swing of our hypothetical cleaver and cut the materials handling function in two. For clarity, materials handling in warehouse and storage type operations must be separated from handling in production shops and similar industrial type operations.

As pointed out earlier, The Chief of the Bureau of Supplies and Accounts is responsible for the storage of Navy material and equipment. It is logical then to expect this officer to be responsible for determining the equipment needed to handle material into and out of the storage facilities and related operations. This logical conclusion is indeed an established fact and the Materials Handling Branch of the Storage Division of the Bureau of Supplies determines equipment requirements for such operations and, in addition, serves as single service purchase assignee for all lift trucks purchased within the Department of Defense.

The administration of materials handling in production shops and industrial type operations is much more difficult to bring into focus. This fact is partly due to the rapid evolution of modern military materials, partially a result of the procedures (sometimes called red tape) which the Congress feels are necessary to safeguard the public funds, and partially a product of the relatively recent advent of materials handling as a separate function in a production operation.

Basically, the responsibility for Naval shipyards, ammunition loading plants, aircraft overhaul and repair activities, and the like, is assigned to the Chief of the technical bureau which is primarily concerned with the end product produced. Responsibility for the handling of equipment through these plants starts with the management engineer in each bureau and filters down to the production engineer or foreman at the activity. Most military operated production plants are essentially large job shops which must be prepared to tackle any job which may be assigned. Because of the numerous short runs of unlike items which military shops must produce, carefully studied and detailed plant and equipment layouts are infrequent. In those instances where a continuing volume of similar products are to be maintained, production lines are set up using, for the most part, equipment which is already available in the plant or which can be obtained without a special appropriation or major reshuffling of the equipment budget. When a special appropriation is required, the time-lag, occasioned by routine appropriation procedures, will be from three

to five years. This frequently means that the characteristics of the item being serviced will be considerably changed from the original item and the production layout must be further revised to be efficient. Delays of this kind are not the result of wilful effort on the part of any individual, rather they are the result of the complex procedures and justifications which are required by law to safeguard the expenditure of public funds. Problems of this nature complicate government operations far more than the average business man realizes.

As Mr. Pike noted on Monday morning, Materials Handling, as a separate industry, is of relatively recent origin. In the warehousing and shipping field, we in the Navy, because of the magnitude of our problem, have developed equipment and procedures which are accepted as guides by industry. In the production field, however, we are looking to you leaders from industry to show us the way.

In the audience at this meeting, there are several Navy representatives who will be listening with real interest to every suggestion which you, Dr. Immer, or Mr. Webber, or any person attending this session may offer. When the Chairman opens the meeting to questions, I will be pleased to attempt to answer your inquiries.

Thank you for your attention.

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Administration of Packaging and Materials Handling Program in the Department of the Army

Mr. H. M. Lovelace
Storage and Distribution Division, Office,
Deputy Chief of Staff for Logistics, Department of the Army

My remarks will be confined to the Army supply phases of packaging and materials handling. I will not cover the Army industrial phases of packaging and materials handling.

Staff responsibility for development and supervision of packaging and materials handling policies and procedures in the Department of the Army is established with the Deputy Chief of Staff for Logistics. Staff Memo Number 4 states that the Storage and Distribution Division "supervises Army storage activities, including materials handling, loading, receiving, shipping, packaging, packing, and marking methods and techniques for supplies and equipment to be stored and the care and preservation of supplies in storage."

a. The technical aspects of packaging policies and procedures and materials handling equipment standardization and specifications are the responsibility of Standards Branch, Procurement Division, Deputy Chief of Staff for Logistics, and are contained in MIL and Federal Specifications and Standards.

b. Storage and Distribution Division, Deputy Chief of Staff for Logistics (DC/S LOG), is responsible for the development of policies, procedures and staff supervision for depot operations and supply functions at Department of the Army (DA) installations in Continental United States (CONUS) and oversea commands. Included in these responsibilities are the operational phases of preservation, packaging and packing and materials handling. Approved packaging specifications and criteria are utilized in packaging operations performed at Department of the Army installations.

As stated before, the Deputy Chief of Staff for Logistics has staff responsibility and supervision over packaging and materials handling policies and procedures for DA. These DA policies and procedures are followed and/or implemented by the Chiefs of Technical Services and The Adjutant General, the CONUS Army Commanders, and the Oversea Commanders at DA supply installations under their control. (TM 38-402 and AR 780-10).

The Commanding Officer of each supply installation in CONUS and oversea commands is responsible for the application of DA packaging and materials handling policies and procedures. The performance of these functions is a responsibility of the Chief, Storage Division, at each supply installation (SR 780-5-1).

In DA the materials handling and operational packaging functions are the responsibility of storage offices at all echelons of command.

Definitions of "materials handling" and "packaging" are contained in the DA Dictionary of United States Army Terms, SR 320-5-1, dated November, 1953.

a. "Materials Handling - the movement of material, other than by common carrier, into and out of storage."

b. "Packaging, in storage operations, cleaning, preserving, wrapping, waterproofing, and identifying one or more identical items as a unit."

In connection with the overall application of the word "packaging," the Army also includes the terms, "preservation," "packing," "marking," and "care of supplies in storage." These are also defined in the Dictionary of U. S. Army Terms.

A Joint Military Packaging Training Course is conducted at the Rossford Ordnance Depot, Toledo, Ohio, for personnel of the three military departments and industry. This course is available to military and civilian personnel of the Army, Navy, Air Force and Marine Corps, and civilian personnel from industry. Each Army technical service is allocated a certain number of personnel spaces for each course. The course is designed to instruct and train personnel in all phases of packaging, including experience on preservation, packaging and packing lines at the depot. Approximately 5,200 military and civilian personnel from Army supply installations have attended the course at Rossford since it began in October 1950.

Based on DA policy, the Storage Division of each supply installation is responsible for training all storage personnel. This responsibility includes materials handling equipment operators and operational packaging personnel.

a. The latest policy and procedure for on-the-job training of materials handling equipment operators is contained in the first increment of the Joint Storage and Materials Handling Manual, dated June, 1955. The Army number on this manual is TM 743-200. The Joint Storage and Materials Handling Manual is applicable uniformly to the Army, Navy, Air Force and Marine Corps. The procedures in the Joint Manual for conducting the training course for materials handling equipment operators are complete and do not require further implementation.

b. Prior to publication of the materials handling equipment operator training procedures in the Joint Manual, the Army used DA manuals, TM 21-302, dated February, 1945, and TM 21-302-A, dated December, 1945, subject: "Operator Selection and Training, Materials Handling Equipment."

c. DA personnel who have completed the Joint Military Packaging Training course and who are employed at Army supply installations, form the nucleus of instructors to conduct on-the-job training in preservation, packaging, packing, and marking methods and techniques. Their knowledge and experience also benefit the Army through work performed in preservation, packaging and packing operations.

Within the Department of the Army, the Quartermaster General is responsible for specifications, requirements, funds, purchase and inspection, storage and issue, and maintenance of standard materials handling equipment (SR 700-51-155). In connection with this responsibility, Army Regulation AR 728-3900-1, subject: "Operation and Use, Utilization of Materials Handling Equipment," was published 22 March 1955. This regulation sets forth the responsibilities and procedures for compiling and reporting data pertaining to the utilization of powered materials handling equipment at depots and ports of embarkation in the continental United States.

a. Commanders of Army depots and ports in CONUS are responsible for obtaining maximum efficiency in the operation of powered materials handling equipment sonsonant with the discharge of assigned missions.

b. The Quartermaster General is responsible for the allocation and control of powered materials handling equipment in accordance with the needs of each installation and for providing technical supervision and guidance in its utilization.

c. Each depot and port keeps a daily operating log for each piece of powered materials handling equipment which shows number of hours the piece of equipment was in operation, the idle time, deadline time, and time in scheduled maintenance. This information is consolidated for the monthly report and includes the percent of utilization for each piece of equipment during the month. The reports are forwarded to The Quartermaster General's office each month for consolidation and analysis of data. The Quarter Master General furnishes one copy of the consolidated report with analysis quarterly to Deputy Chief of Staff for Logistics and to each Chief of Technical Service.

d. The information compiled on the reports are used by the heads of technical services and commanders of depots and ports as a management tool to insure proper application of equipment to the Army materials handling program. Application of information generated by the procedures will result in overall economy in supply installations and establishment of materials handling fleets at a level required for normal operations.

A Department of Defense Instruction, Number 4145.11, was published 29 August 1955, subject: "Materials Handling Equipment Utilization and Allowances." The purpose of this DOD Instruction is to:

a. Establish uniform criteria for determining the quantitative requirements and allowances for peacetime and for mobilization operations for the principal items of materials handling equipment.

b. Provide a means for determining the quantities of each type of equipment required by an installation to perform its materials handling functions under its normal mission.

c. Prescribe reports and management data pertaining to the effective application of criteria and management analysis of the equipment utilization. The DOD Instruction is applicable to Army, Navy and Air Force.

The Office, Deputy Chief of Staff for Logistics has taken action to implement DOD Instruction 4145.11 for the Department of the Army. The new Instruction is applicable to depots, depot storage branches, supply centers, air and water terminals (including ammunition terminals) and holding and reconsignment points in CONUS and oversea commands. Utilization factors for materials handling equipment are based on an

eight hour workday. The factors are expressed as a percentage of the utilization potential during an eight hour work period. Where appropriate, allowances have been made for deadline, scheduled ship maintenance, operator maintenance, and similar elements which prohibit full time productive use. The factors shown are considered as representing the minimum effective utilization.

UTILIZATION FACTORS, POWERED MATERIALS HANDLING EQUIPMENT

Equipment	Minimum Utilization Factor
Truck, Fork Lift	.50
Tractor, wheeled, warehouse	.50
Crane, Track, Warehouse & Industrial	.25
Truck, Lift, Hand, Pallet Type	.60
Truck, Fixed Platform	.60
Truck, Straddle, Carry	.50

A coordinated DA preservation, Packaging and packing policy was developed by DCofS for Logistics, 27 July 1954, covering "Levels of Protection" (changes 2 and 3, AR 740-15). The statement of policy on Levels of Protection was published to emphasize economy in preservation, packaging and packing of supplies. The statement of policy and the levels of protection are quoted for your information:

Quote Paragraph 4, AR 740-15, changes 2 and 3.

a. Implementation of the DA policy on levels of protection is a responsibility of the Chiefs of Technical Services for all supplies under their control.

b. On 20 July 1955, a Department of Defense Instruction, Number 4100.14, was published, subject: "Uniform Preservation, Packaging, Packing and Marking of Items of Military Supply." This DOD Instruction sets forth six objectives, and incorporates the three levels of preservation, packaging and packing that I quoted from AR 740-15.

The military departments are responsible for implementing the DOD Instruction. In the Army, DCof S for Logistics is responsible for publishing the implementing policy. Chiefs of Technical Services develop the detailed procedures for the preservation, packaging and packing of their supplies, based on the DA policy. Application of procedures is a responsibility of all supply installations in CONUS and oversea commands.

Determination as to the effectiveness of DA policies and procedures is through staff visits to installations and review of various reports pertaining to packaging and materials handling operations.

Administration of the Air Force Packaging and Materials Handling Program

Major W. J. Mayhall
Air Force Office, Directorate of Transportation

I am going to take about twenty minutes this afternoon and outline for you how the Air Force administers its packaging and materials handling program. In attempt to show you how many agencies are involved in this very complex subject, I am going to trace the flow of information and control from Headquarters to the field and outline generally our objectives and how we expect to accomplish them.

Before we get too deep into this we should clearly understand just what packaging and materials handling entails. The terms are used in the broadest possible sense. "Packaging" includes techniques, skills, materials, facilities and equipment combined to accomplish the function of cleaning, preserving, packaging in unit quantities, cushioning, blocking and bracing, design and application of containers and the identification of contents. Included within "materials handling" we visualize the combination of skills and equipment for handling in any form during manufacture, shipment, storage, repair and the loading or unloading of carriers. Throughout this discussion, my comments will apply to both packaging and materials handling since we feel they are inseparable. This has not always been the case.

The first recognition of the need for staff level surveillance of the packaging and materials handling area was in 1943 when we commenced to learn of the excessive degree of waste due to deterioration and damage of our critical war materials being received by our overseas forces. In the next ten years, various approaches and studies were conducted seeking a sound program. Generally, however, the efforts were loosely organized and too diverse. The first office established in Air Force Headquarters was in 1948 in an effort to tie up all the loose ends and resolve a workable program. Late in 1953, after the Korean War again placed emphasis on the need for a better system, all previous work on the subject was reviewed and evaluated and the decision made to combine all previous efforts under one office. This problem was presented to Major General John P. Doyle the Director of Transportation.

General Doyle after considering all the ramifications involved, organized a Packaging and Materials Handling Division to serve as the staff focal point for all related matters. The major requirements existing at that time was a clearly defined policy, a statement of objectives, and an

organizational structure to carry them out. By July of 1954 we were in business. All previous instructions to the field had been completely revised and a new Air Force regulation published to establish guidance for a revitalized program.

These are the objectives: For materials handling, it is necessary to maintain maximum effective utilization, distribution and maintenance of our existing assets. Present systems must be evaluated to assure maximum speed, economy and flexibility in handling of materiel to enable us to reduce inventories and gain storage space. The purchase of new equipment and systems must be based on utilization criteria and be standardized to the maximum extent. An extra degree of care is to be exercised in evaluating the need for non-standard equipment. In packaging, we must strive to maintain maximum serviceability of materiel throughout the supply system at a minimum cost of materials, labor, handling, and transportation costs.

This principle must be maintained throughout the flow of materials from manufacture to user, and the return of reparable property from user to the repair facility. It is necessary in packaging to assure maximum life and performance through prevention of deterioration and damage. Packaging should provide a means for efficient receipt, storage, inventory, identification, handling and shipping markings. As an operational policy, packages should be of minimum weight and cube consistent with anticipated storage, and mode of shipment, to prevent overpacking. Air Force methods must be cognizant of those in industry, and be standardized throughout the system.

Having arrived at the broad program objectives, an organization was needed to effectively administer and tie together the highly diversified elements of packaging and materials handling. It was decided under a policy of decentralization, that Headquarters would make policy and establish guide lines, and that Air Materiel Command would operate and carry out the program in detail.

This is the way it operates. The Headquarters at the Pentagon in establishing the guide lines, shares the responsibility among seven directors. The director of Transportation exercises the general staff management for the whole program. This office is responsible to the Chief of Staff for developing the plans and policies for packaging and materials handling activities, and writing the guidance directives necessary to meet future concepts. The Director of Research and Development does all the research and development

of packaging materials and equipment, and materials handling equipment. He furnishes engineering advice, and arranges for all necessary tests to prove the operational quality of Air Force material. The Director of Requirements furnishes the research and development people with the desired military characteristics of all new items and collaborates in the suitability testing.

The Director of Procurement assures that all contracts for material include references to specifications and standards or gives the contractor packaging instructions. The Director of Maintenance determines the maintenance policy for materials handling equipment, and prepares the packaging and preservation instructions for the items coming from the reparable lines. He also furnishes technical instructions on preservation and corrosion control. The Director of Supply supervises the actual performance of packaging lines to assure that specifications and standards are being met. He has the sole responsibility of review and approval over the computation of budget estimates, quantitative requirements and the authorization of equipment to the field. The Director of Installations concerns himself with any fixed materials handling systems or proposed modifications of buildings to accommodate fixed systems.

All these offices have what we refer to as a "primary interest" in the packaging and materials handling program as it relates to their specific responsibilities. All programs, developments and related matters are generally coordinated with these offices to assure the soundness and efficiency of the proposals. The flow of information is two ways and monitored through the Director of Transportation before dissemination to the field.

Now as I mentioned earlier, Air Materiel Command conducts the operation. As the major operator of the program, they develop the procedures for the major commands and the depots to effectively carry out the objectives established by the Headquarters. Air Materiel Command has assumed the technical direction of the packaging and materials handling activities throughout the Air Force. That office monitors the costs of the program and determines the qualification of personnel needed to carry it out. All operational details are developed at Air Materiel Command including the computation of requirements for materials and equipment and the methods for their use. All in all, the initial policy instruction outlines some twenty-six steps which we feel will give us the best possible system.

Major W. J. Mayhall Wednesday PM Oct. 12, 1955
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For Air Materiel Command to successfully meet this tremendous responsibility, it is important to consider here the contribution of Air Research and Development Command and the Military Air Transport Service in the successful development of operational details. Here again the flow of information is two ways. Through the agency of Wright Air Development Center at Dayton, Ohio, Air Research and Development Command has established a laboratory to furnish the very important element of engineering advice. Through their testing facilities, all standards and specifications are developed. In effect, all new items introduced into the Air Force are adjudged by ARDC from a quality point of view before acceptance by the supply and procurement people. Military Air Transport Service shares a place on this three-way team by providing advice on all phases related to air transport. These are such things as packaging requirements to prevent damage and gain low tare weights for air carriers, and methods and equipment for the loading and unloading of aircraft. They serve as a testing facility in collaboration with AMC and ARDC to evaluate new developments. This three-way effort is essential in order for AMC to discharge its responsibility.

Up to now, I have tried to show you the flow of information and control between the Headquarters here at the Pentagon, Air Materiel Command at Dayton, and all the related agencies necessary to furnish the guidance to successfully operate the program. To complete this picture, we must look for a moment on the part played by the Major Commands and the AMC Depots. These people after all are on the receiving end of all this management and are the proving ground for the soundness of policies and procedures through everyday use.

For this reason they are encouraged in their daily operation to develop any improvements in our system, and to recommend any changes to Air Materiel Command for evaluation and recommendation to Headquarters, USAF. Through the medium of AMC, any management improvement ideas, or methods and procedures, generated by one depot or command is collected and passed on to the other depots or commands for consideration and adoption. In this manner, the individual experience gained in the field is brought to the fore front for review and evaluation and this in turn aids in the development of a better system for the packaging and materials handling program. Although we still have a long way to go, we feel that we are on the right track and progressing at a satisfactory rate.

Organizing for Materials Handling and Packaging

Mr. R. Frank Weber
Packaging Editor, Modern Materials Handling
Chairman, Materials Handling Advisory Committee, N. S. I. A.

My first experience in organizing packaging and handling dates back to 1918, when my predecessor in Harvester - Theo. Morganweck, returned from Washington. He told me how he and Mr. Fitzgerald of General Electric and Don Quinn of Chicago Mill and Lumber Company had organized the packing for the Army during World War I.

Shortly after his return, Mr. Morganweck arranged with each works manager to assign a plant man to do something about packing and shipping. I started this job at Milwaukee Works as a part-time assignment, continuing on special production, which was my regular work. The term "Materials Handling" was not used at that time, although there was plenty of material movement, under the designation of "trucking." This was my first experience in organizing packing and shipping.

The next big step in this assignment, did not occur until 1936, when I was asked to take over these activities for all Harvester plants. I attended an AMA Packaging Committee meeting the same year and learned more about the planning of packaging programs.

During World War II a great deal of emphasis was placed on the handling and packaging functions by the Military, with which most of us had some contact. This Military experience I feel was the opening gun in industry, following the war, — starting a move of organizing for better packaging and handling, which has gained a lot of momentum in the past few years.

The question is sometimes asked, "What are the motivating factors in industry back of a program of this kind?"

To illustrate — in 1946, after the experience I had gained with the Military Services and with industry contracts, I went to the Harvester Executive Vice President, Bill Worth, and suggested a plan which I thought would work in organizing materials handling and packaging. A three-day conference was arranged of staff representatives from each plant, together with general office executives interested, and the program became effective immediately. An advisory committee representing all divisions was appointed to help administer the plan. I acted as Chairman in my position as General Supervisor of Materials Handling Research.

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WHAT ARE THE PRESENT TRENDS?

Labor and material costs have been on an upward trend, especially during the past few years. We hear a great deal about the Guaranteed Annual Wage and other benefits to labor that must be paid for by industry and will mean increasing product costs. With the effort of industry to maintain a price level that will continue to sell their products at the present volume, businessmen are looking for areas in their operations to effect large savings. There has been some acceleration in activity in recent years to reduce these costs, especially in materials handling and packaging, but on a national basis only a small percentage of industries are making a real effort to properly plan and organize these functions.

We are assured that an acceptable program in materials handling and packaging, of real benefit to industry, will have hearty acceptance. Management never has been so vitally interested in improving their handling and packaging methods as they are today. The biggest single item of expense in productive labor as we all know is for materials handling. Thomas A. Pike, Assistant Secretary of Defense, Supply and Logistics, stated in his talk on Monday that 50 percent of production labor in industry was related to materials handling. Also, that the annual outlay for packaging was about 10 billion dollars. Business executives are going to make sure that with the money they have to spend for improving their facilities, they will receive the greatest possible return. Well planned and well organized handling and packaging programs will give them the biggest dividends and the most benefits for every dollar they spend.

WHAT ARE SOME OF THESE RETURNS?

(1) Reduction of labor cost as much as 10%
(2) Savings in materials, above 20%
(3) Savings in freight charges, up to $70.00 per car
(4) Economies in warehouse space at least 30%

There are other benefits, under a well organized program, quite as important as financial returns.

These could include —

(a) Reduction in labor turnover
(b) Improved quality of product
(c) Safer working conditions
(d) Better services to customers

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In order to determine present trends in organizing and packaging, surveys were conducted earlier this year among a group of industries, both as to size and variety of products. From these groups of manufacturing operations, representative organizations have been selected for method of operation and degree of accomplishment. Through "Modern Materials Handling" magazine, we included in this survey the various titles under which supervision for these functions were assigned. On a functional basis, we found some semblance of uniformity, as 84 percent of the companies reporting in the survey had already combined materials handling and packaging under one head. It was pleasing to note a great deal of progress had been made in assigning these functions to management or staff personnel which has upgraded the authority. However, outside of the larger operations, there seemed to be a lack of coordination in many industries, that retarded progress that might otherwise have been made.

The functional slides will show the popular concept of materials handling as comprising the entire cycle of movement, from receiving to sales distribution. By including all phases of this cycle under the jurisdiction of the man in charge of materials handling or packaging, we have better control of the safety of products in handling and shipping and can protect them for all phases of movement to the ultimate destination, whether domestic or overseas.

A BASIC OUTLINE OF A GOOD PROGRAM WILL COMPRISE PLANNING, ORGANIZING, RESEARCH AND DEVELOPMENT.

The planning of a materials handling and packaging program unusually is initiated by a staff group. The plan is then submitted to the Executive and Divisional Heads. As soon as approved, the plan is passed on to Works Managers. The advisory function is performed by the staff group initiating the plan. It is advisable to make a study of industries with successful handling and packaging organizations to profit by their experience. At least once each year the program should be reviewed for changes or improvements.

Under the organization phase there is a clear cut line of authority for the materials handling and packaging function. The individual in charge, usually the materials handling engineer, reports to Management as a staff man. In a large company, as already indicated, he might be a consultant to all operating staff divisions, as well as to Works Managers of individual plants. In a small company, usually he is part of the plant organization and reports to the Works Manager.

ORGANIZATION GROUP	PERCENTAGE %	TYPICAL TITLES	PREDOMINANT INDUSTRY SIZE
TOP MANAGEMENT	15%	PRESIDENT VICE PRESIDENT GENERAL MANAGER BUSINESS MANAGER OWNER	SMALL
WORKS MANAGEMENT	35%	CHIEF ENGINEER WORKS MANAGER GENERAL SUPERINTENDENT FACTORY SUPERINTENDENT HEAD - METHODS AND RESEARCH	MEDIUM
PLANT STAFF GROUP	33%	INDUSTRIAL ENGINEER PACKAGING ENGINEER MATERIALS HANDLING ENGINEER DIRECTOR OF PURCHASING TRAFFIC MANAGER	LARGE
SUPERVISORY GROUP	17%	SHIPPING SUPERVISOR SUPERVISOR OF STORES FOREMAN MAINTENANCE SUPERVISOR EQUIPMENT SUPERVISOR	SMALL

Figure 153 - Management level and job titles of persons responsible for packaging and materials handling.

PLAN	1 - SURVEY THE FIELD FOR CURRENT WELL ORGANIZED SYSTEMS. 2 - SELECT THE BEST METHOD FOR YOUR INDUSTRY. 3 - EMPHASIZE THE OBJECTIVES AND BENEFITS. 4 - APPROVAL BY EXECUTIVE STAFF. 5 - REVIEW PERIODICALLY FOR IMPROVEMENT.
ORGANIZE	1 - PICK THE RIGHT MAN TO EFFECTIVELY CARRY OUT THE PROGRAM. 2 - GIVE HIM STAFF RANKING ON YOUR MANAGEMENT TEAM. 3 - SELL THE PROGRAM TO EVERYONE INVOLVED IN YOUR COMPANY. 4 - ESTABLISH APPROVED TRAINING METHODS. 5 - INITIATE AN EFFECTIVE COST CONTROL METHOD.
RESEARCH	1 - RESEARCH IS ESSENTIAL TODAY TO PROVIDE A BASIS FOR PROGRESS. 2 - ASSIGN A PLACE IN YOUR OPERATIONS FOR RESEARCH STUDIES. 3 - COORDINATE YOUR EFFORTS WITH OTHER RESEARCH PERSONNEL. 4 - RESEARCH PAYS OFF IN BOTH SMALL AND LARGE INDUSTRIES. 5 - THROUGH RESEARCH "WE IMPROVE THE METHOD AND REDUCE THE COST".
DEVELOP	1 - APPLY THE IDEAS FROM RESEARCH TO YOUR OPERATIONS. 2 - SELL THEM FOR PROPER ACCEPTANCE TO THE ORGANIZATION. 3 - MAINTAIN INTEREST IN SUPERVISORY GROUPS TO DEVELP ON JOB IDEAS. 4 - HELP YOUR STAFF IN DEVELOPMENT OF BETTER METHODS AND FACILITIES 5 - THE ENTIRE MATERIALS HANDLING CYCLE IS YOUR DEVELOPMENT PROGRAM

Figure 154 - Basic steps in organizing an effective packaging and materials handling program.

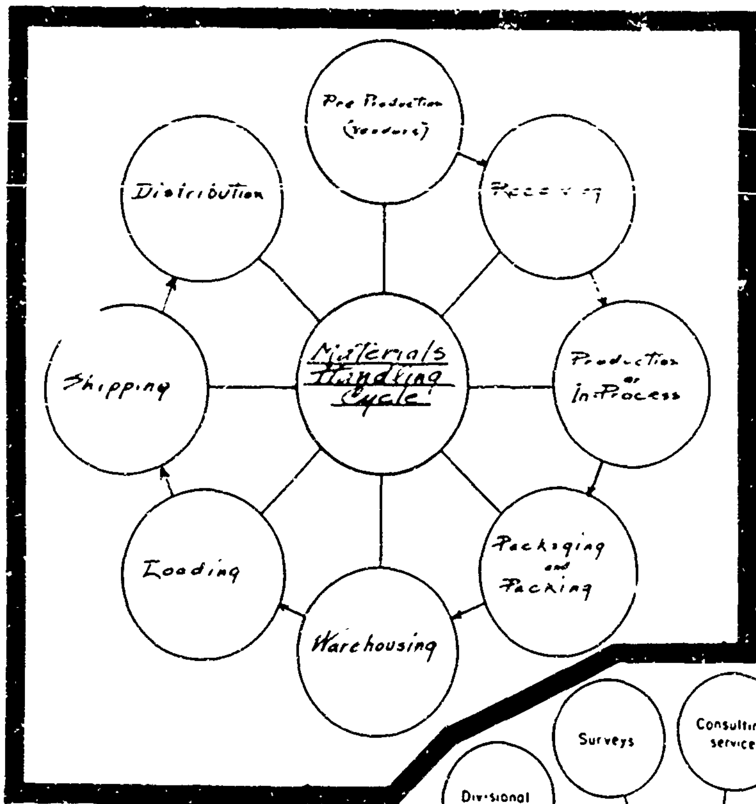

Figure 155 - The Materials Handling Cycle

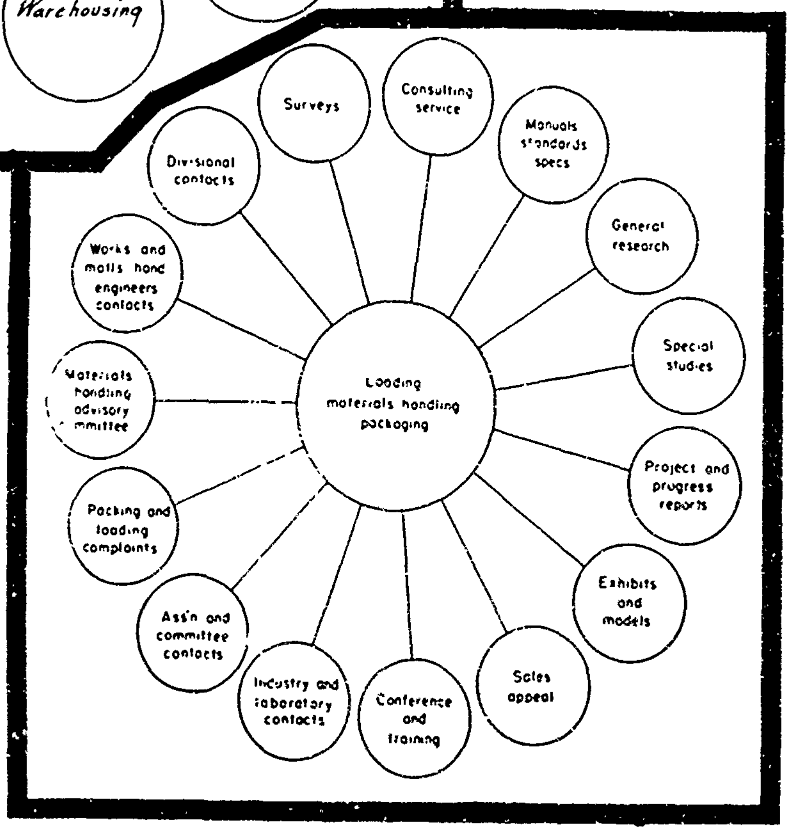

Figure 156 - Functional Chart of the Materials Handling Cycle

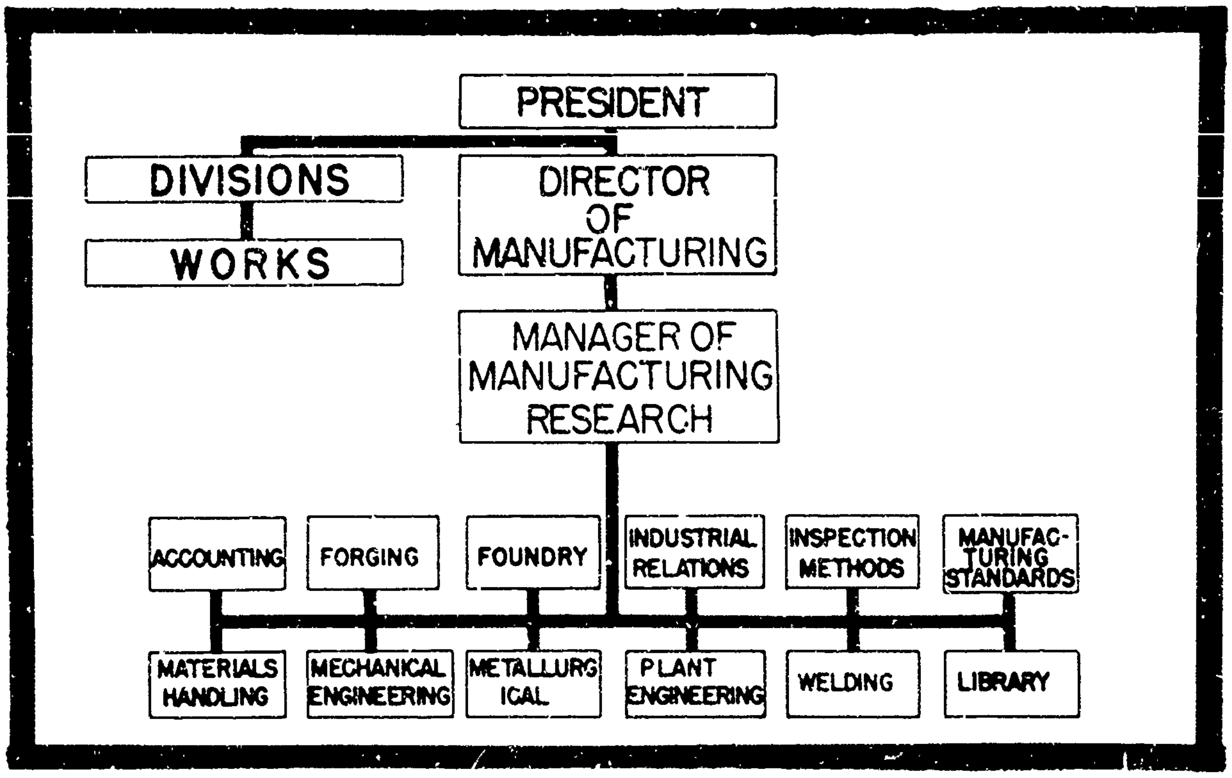

Figure 157 - Position of the Manufacturing Research Department in a large multi-plant corporation

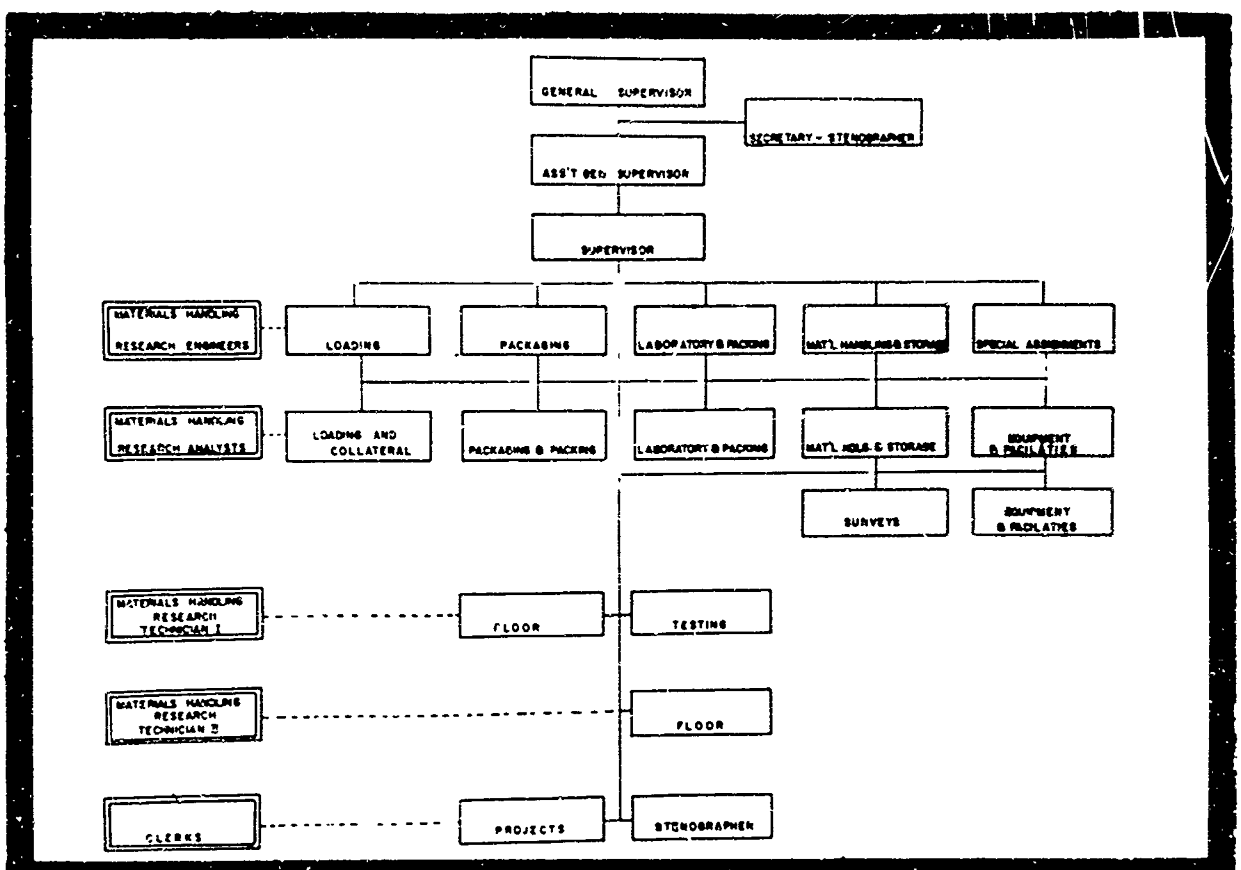

Figure 158 - Organization for materials handling in a Manufacturing Research Department

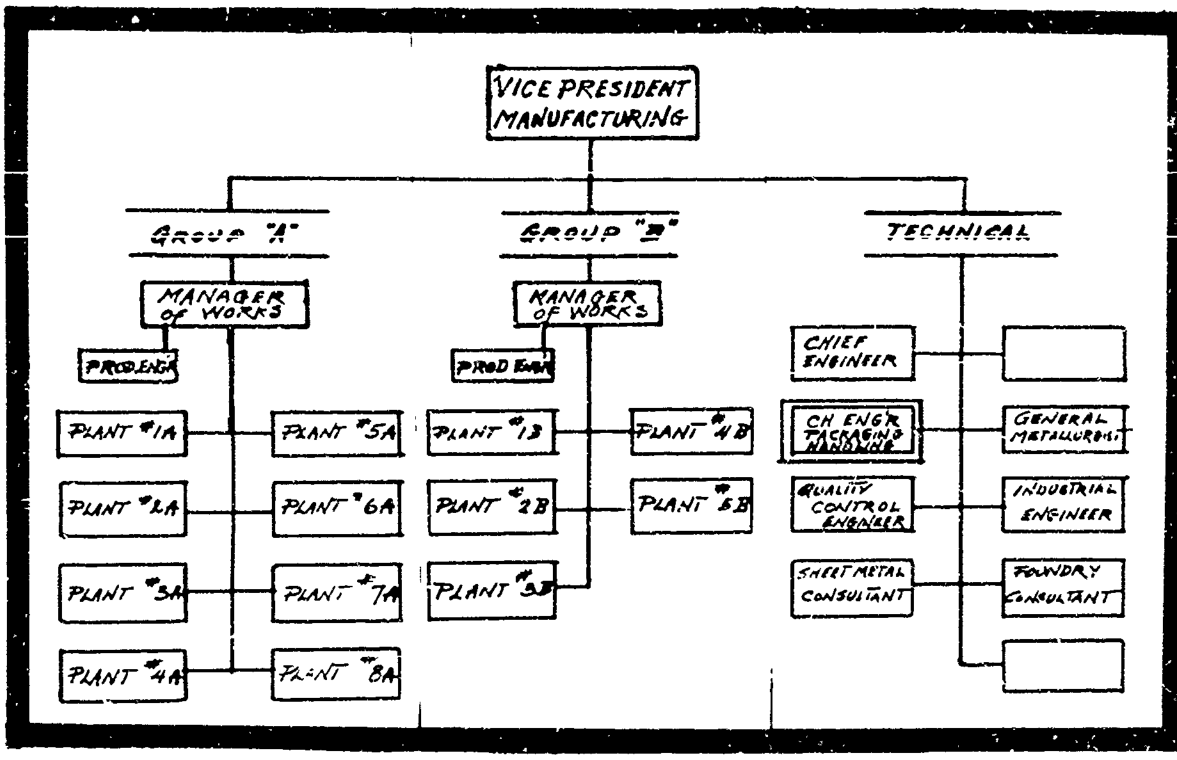

Figure 159 - Relationship of technical and staff functions in a multi-plant organization

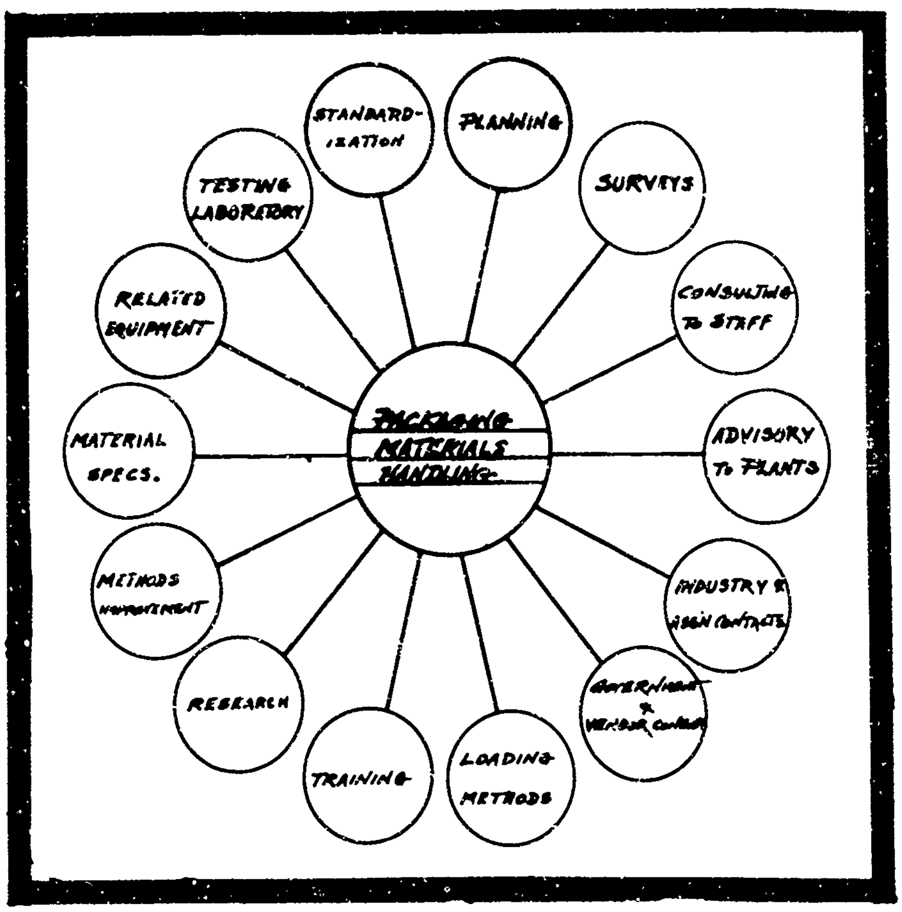

Figure 160 - Responsibilities of the packaging and materials handling engineer in a single-plant organization

He also helps establish training methods; he works with the Accounting Department in developing cost control systems. In a general way, he performs the duties outlined in the functional circle chart.

In modern industry, the research function in handling and packaging is just as vital as in any other essential manufacturing operation. The question often arises, "Materials handling and packaging research might well apply to the large industries, but the small manufacturers cannot afford it." We have found that one good man assigned to packaging and handling research in a small industry should pay off as well as a staff of research men in a large company. It is not the elaborate setup that always gets the best answers. The experience in small industries starting a laboratory of this kind has been favorable where the program has been well planned.

The large handling and packaging laboratories devote much of their time to the potentialities ahead. They help establish trends.

The commercial and suppliers' packaging laboratories are doing much good in this respect. They provide reliable services that some of the smaller industry laboratories cannot take care of.

In a recent survey of a medium size (2,000) electrical control industry, we learned that the equipment and installation cost for their packaging laboratory was approximately $15,000, the annual operating cost $13,500 and the annual cost reduction averaged over $40,000.

In the development phase the materials handling and packaging engineer does most of his constructive work. He makes the program tick. His interest and enthusiasm provide the impetus to put the program over. Management depends upon him to keep the plant organization sold. This is part of the overall program. Most of the new ideas come from the supervisory group and he must keep them on his team. Through his efforts, they cooperate with the research laboratory in an exchange of ideas. He helps them with equipment, facilities and layouts to improve packaging and handling. He should make materials handling one of their most important duties. Much of the improvement in the new program development will be suggested from the experience collected in these groups.

Mr. R. Frank Weber
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Wednesday PM Oct. 12, 1955

CONCLUDING REMARKS

I believe I can safely say I know a great deal about your handling and packaging problems. I am sure I can put myself in your places because I have gone through the "mill" and have been handled very roughly, perhaps rougher than some of the items that are packed and shipped. The tougher the task, the more of a challenge it represents, whether in the military or in industry.

We must be confident of our rightful place in the organizational picture. I feel the progress we make lies with us as much as it does with management or top staff.

The trend today points in the direction of giving the materials handling and packaging engineers more authority and more freedom, in developing their programs, in assuming greater responsibility, and in conferring with executives. The success or failure of the program at the end of each year will be that of the handling and packaging engineers.

Some years ago, at a Harvester management meeting, A. E. McKinstry, then President, used the term "Righteous Militancy" to impress these men with the importance of their mission in the company. This slogan of "Righteous Militancy" might well apply to materials handling and packaging engineers.

We know we have one of the biggest and most essential jobs to perform, in organizing the handling and packaging functions, both in the military and in industry. Let's tackle it with determination and confidence to make it a highly successful accomplishment.

MR. C. K. HALL (Office of Naval Material): Noticing the different position titles shown in your slides, is that indicative of different materials handling functions?

MR. WEBER: If the company takes time out to pay some attention to materials handling, I think it is a very good indication. We found that 95 percent of these 25,000 companies had the materials handling function assigned somewhere in the organization.

MR. HALL: I had in mind the job titles, that of a manager or director.

MR. WEBER: This will depend upon the size of the company. I believe that if we made a survey a year from now we would find a change. More attention would be given to the materials handling and packaging functions in the overall organization.

DR. J. R. IMMER (Work Saving International): Several years ago the General Foods Corporation instituted a plan of "controlled distribution." They were concerned with all aspects of the movement of grain from the farm to the breakfast table. They considered every handling operation as a part of the complete transportation cycle.

CAPT E. K. VAN SWEARINGEN (Navy Bureau of Ordnance): Did that include the duties of the traffic manager?

MR. WEBER: Traffic managers often include some of these functions in their duties. It is not so much a matter of title as it is the specific function performed.

DR. IMMER: At General Foods, as at many other larger corporations, materials handling comes under the traffic manager. This depends largely upon the relative importance of materials handling compared to other production activities.

MR. J. E. BENJAMIN (Benjamin General Precision Laboratories, Inc.): How does production control affect this relationship?

MR. WEBER: From the analysis we have made we found that the materials handling engineer is interested in equipment, layouts, conveyors and machinery. Today, top management wants the materials handling engineer to do something about lowering costs and increasing production. As a result of this emphasis, materials handling engineers are concerned more with production than with engineering or planning.

DR. IMMER: They will spend a part of their time on production control problems. Most materials handling problems are a result rather than a cause in itself. The engineer is not called in, generally, unless something is wrong and somebody is getting hurt. Often the congestion and inability of the system to handle materials thrust upon it are caused by faulty production control rather than by any defects in the handling side of the system.

It is an established trend in larger companies to have a well developed advisory staff on materials handling, packaging and layout. This arrangement provides an in-built consulting service to the company which has proved to be extremely useful.

MR. WEBER: A good example of this is the Manufacturer's Research Division of the International Harvester Company which includes a section on Materials Handling and Packaging. This specialization in the staff provides experts in all fields to assist the production departments in their problems.

MR. D. J. OLSEN (Merck & Company, Rahway, N. J.): In industry in general, do you think that research in materials handling is strictly a staff function?

MR. WEBER: No, I don't. Improved methods of handling must be developed on the factory floor. New methods are developed in response to needs for greater production at less cost. Along with this, materials handling engineers want advances in the field of research. Information on new ideas, new methods and new equipment and materials must be obtained from other organizations and other sources. There is an important function for a staff that furnishes information to materials handling engineers on a plant level.

MR. IMMER: Gentlemen, the purpose of this discussion has been to bring together some ideas of administration and organization relative to materials handling. The effects of the best techniques and equipment are less important than the proper integration of the materials handling functions into the overall organization. This is a problem that industry and the military have in common. We have come a long way in getting recognition for the functions of materials handling and packaging both in the operating picture and in the area of research, both practical and theoretical.

Two salient thoughts emerge from this discussion. All the materials handling functions must be planned so as to fit into the total operating requirements of the organization. Finally, somewhere in the organization someone should have a complete picture of the complete handling cycle.

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